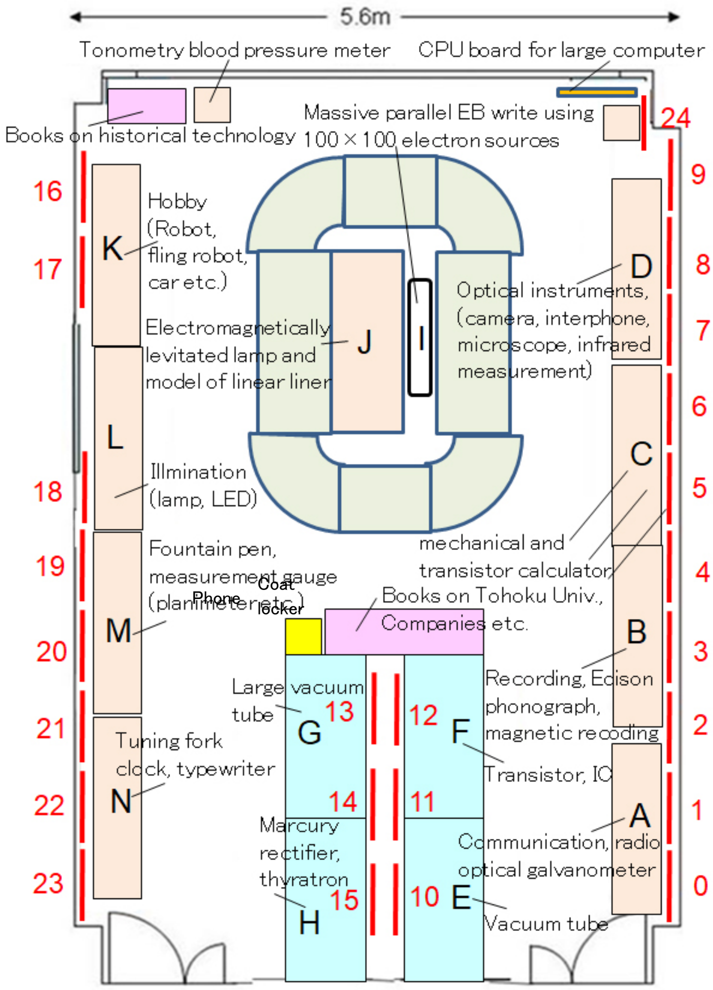
0 Historical Museum of Technology



Poster

0 Historical museum of technology
1 Electrical measurement
2 Wired communication
3 Wireless communication
4 Recording
5 Calculator (1) (Analog)
6 Calculator (2) (Digital)
7 Optical instruments (1) (Camera)
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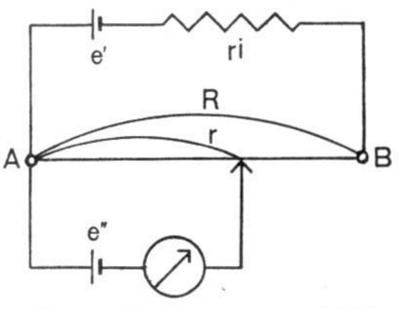
18 Automobile
19 Illumination and lighter
20 Fountain pen
21 Measure gause.
22 Clock
23 Typewriter
24 Kiyota Manufacturing Co. – Contact probes –

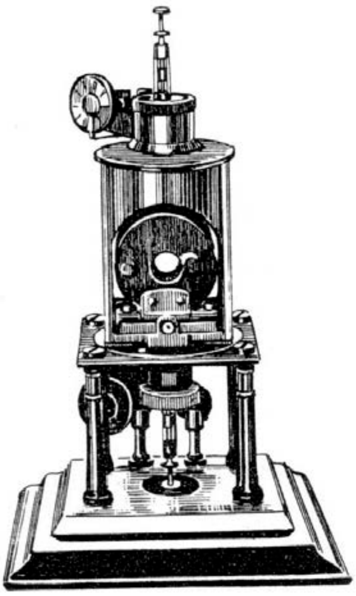
1 Electrical measurement



R, r_i ··· constant $e'' = \frac{r\,e'}{R + r_i}$

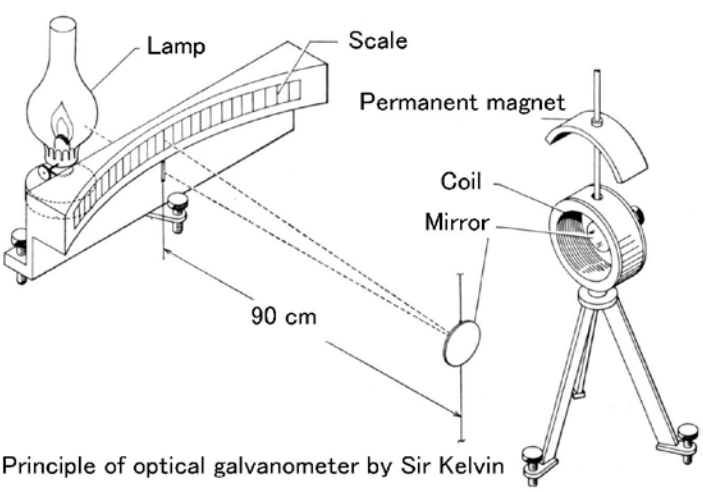
Prof. William Thomson
(1824–1907, Sir Kelvin)
Glasgow University

Potentiometer (measurement of electromotive force with zero current)



First galvanometer by Sir Kelvin

Optical galvanometer (1)

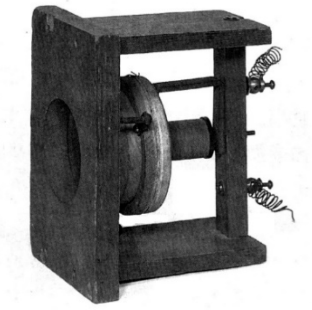


Principle of optical galvanometer by Sir Kelvin

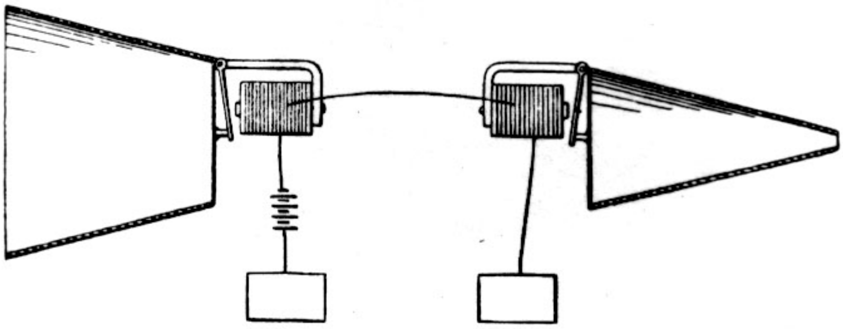
Optical galvanometer (2) (sensitivity 0.02 μA)

(J.Takagi, "History of electricity", Ohm Ltd. (1967))

2 Wired communication

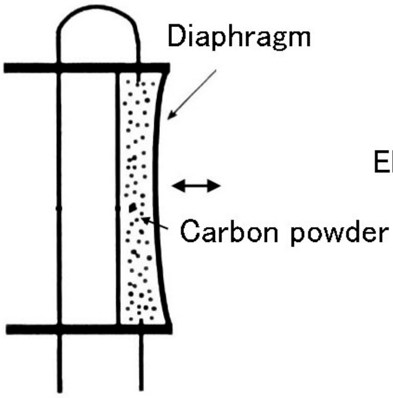


Microphone of telephone invented by A.Bell.
"Mr. Watson. Come here. I want you"
was the first voise.

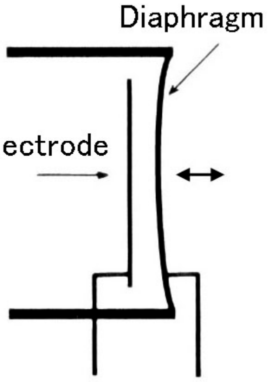


Telephone by A.Bell (1876) Electromagnetic microphone and receiver
(I.Sagara : History of electronics in 20th century, Nikkei electronics (1996))

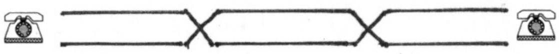
Electromagnetic receiver and carbon microphone



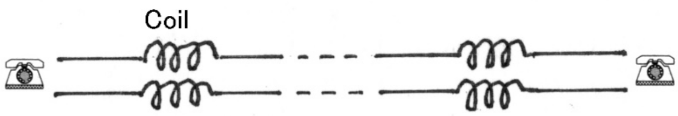
Carbon microphone
Edison (1877)



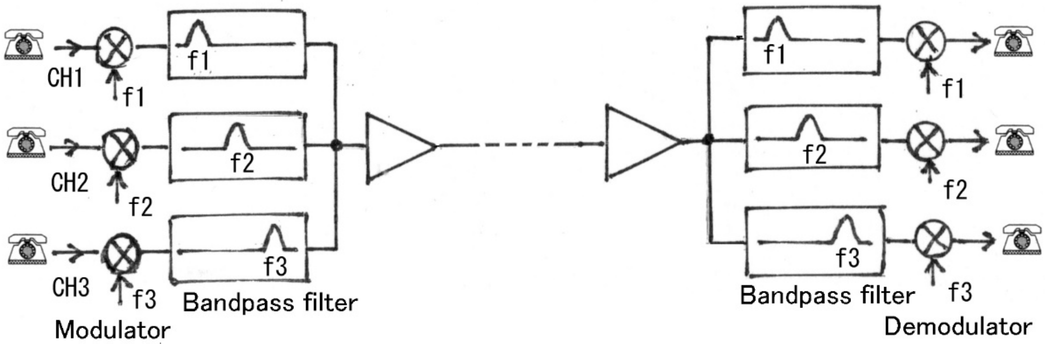
Condenser microphone



(a) Balansed twisted cable



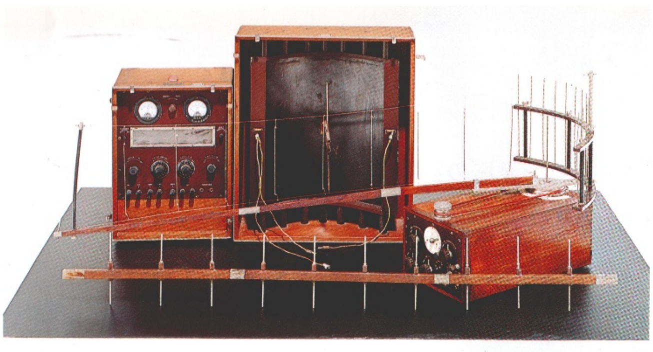
(b) Loaded cable (M.I.Pupin (1899))



(c) Multipled communication using unloaded cable (S.Matsumae (1932))

Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

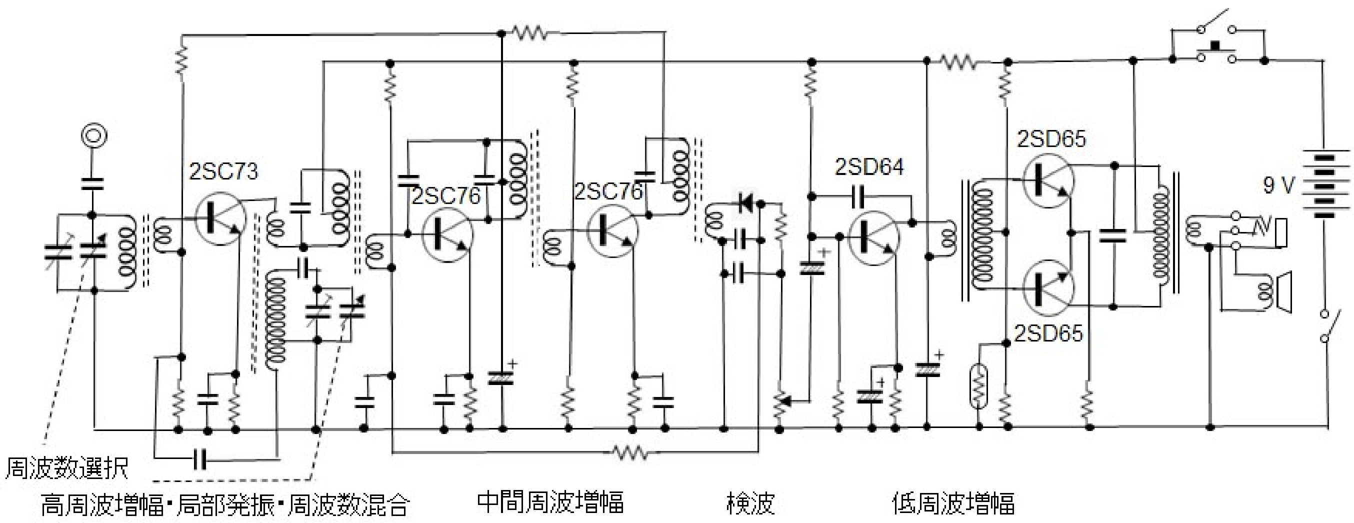
3 Wireless communication



Yagi antenna (1928) ("Tohoku University" 2007/8/1)

Vacuum tube radio [1]

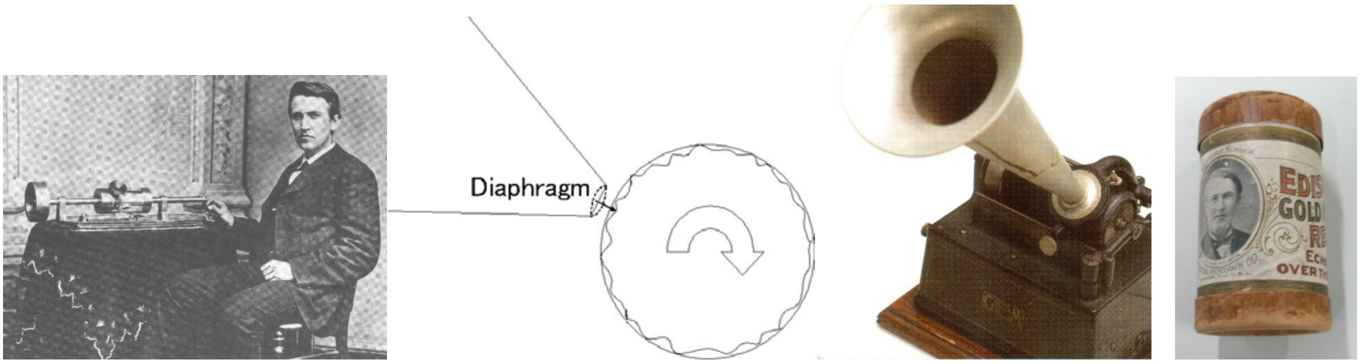
Transistor radio (Sony TRW-621)(1960)
(Clock can be used as timer) [2]



Transistor radio circuit (Sony TRW-621) (1955)[2]
https://www.radiomuseum.org/r/sony_TRW_621

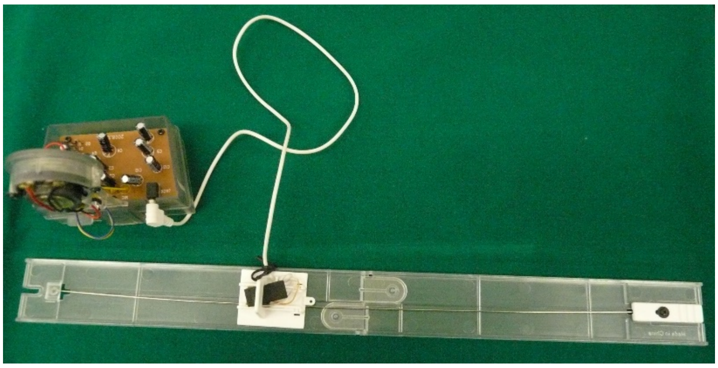
[1] Donation by Mr. Masami Tawara (Optoelectronics)
[2] Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

4 Recording

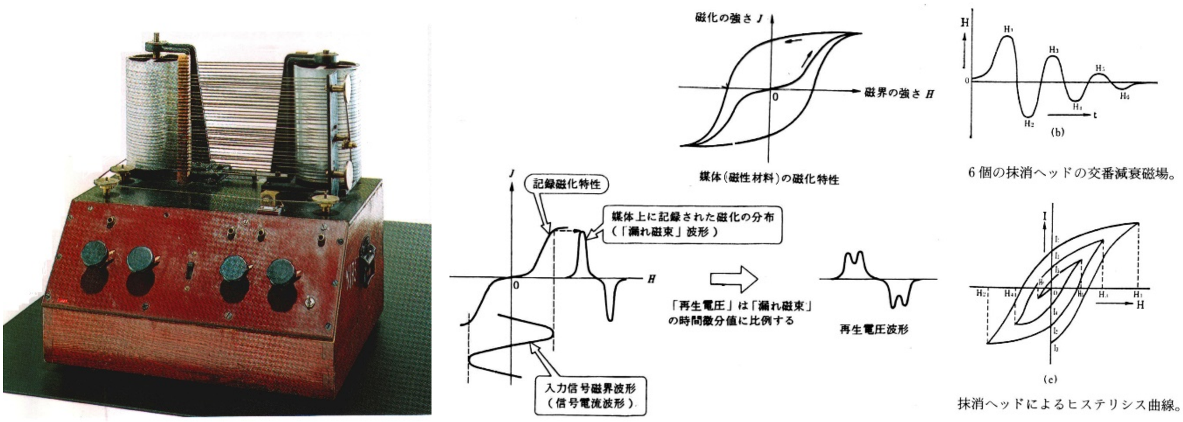


Edison and phonograph (1877) [1]

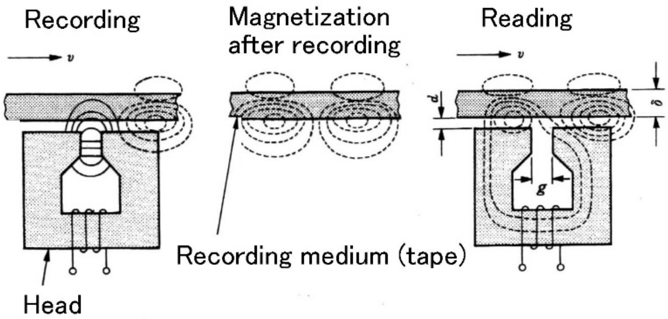
Magnetic wire recording by V.Poulsen (1898),



Magnetic wire recording (Gakken)



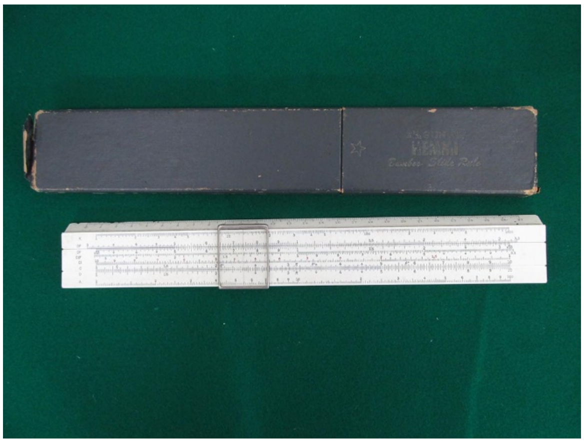
AC bias recording (K.Nagai (Tohoku University)

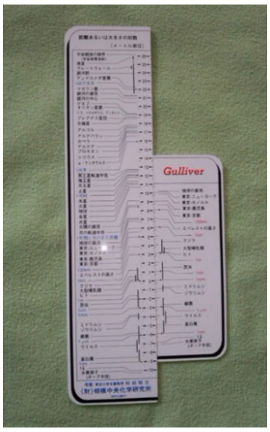


Vacuum tube tape recorder (Sony)

[1] Donation by Mr. Masami Tawara (Optoelectronics)

5 Calculator (1) (Analog)



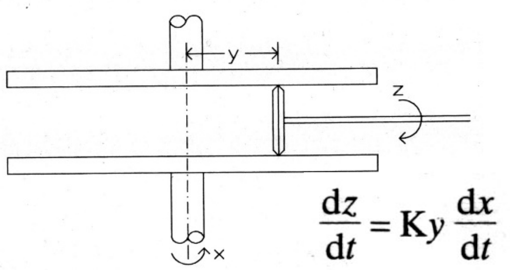


Time and Size can be transformed to equivalent ones which we can imagine using the logarithmic scale.

Time Size Equivalence Scale [1]

Banboo Slide Rule[1] (logAB = LogA+LogB)　　　[1] Donation by Emeritus Prof. Yakichi Higo

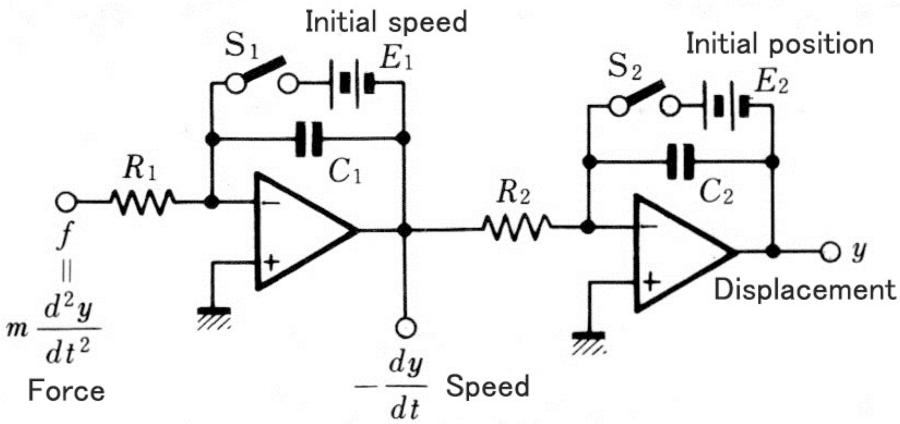
Differential Analyzer (https://www.tus.ac.jp/info/setubi/museu



Example of element of mechanical computer (Hermann integrator) (A.Ben Clymer, The mechanical analog computers of Haannibal Ford and William Newell, IEEE Annals of the History of Computing, 15, 2 (1993)

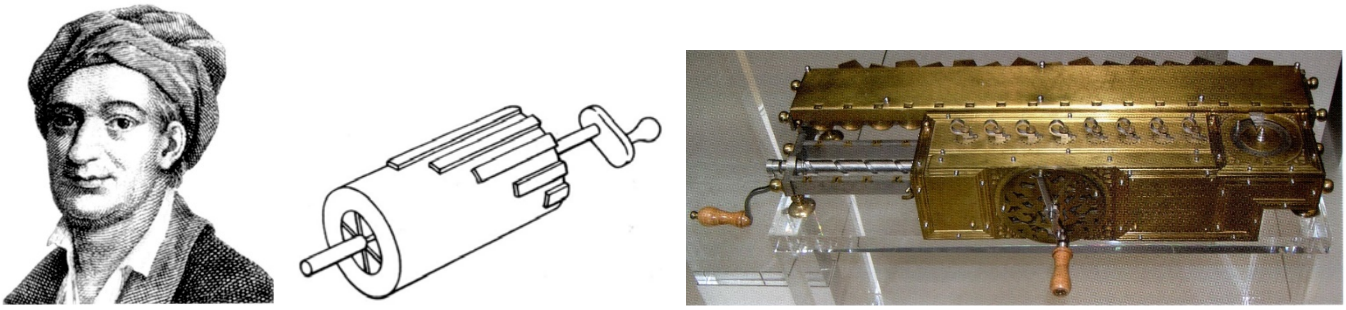
Differential Analyzer is a mechanical analog computer to solve differential equations. It was invented by Prof. V.Bush in MIT in 1931. The machine in the photograph in Tokyo University of Science was used in Shimizu laboratory in the department of mathematics. The principle is an integrator by drawing some area.

Analog computer using operational amplifiers is an electronic computer to solve differential equations. Motion equation is f = m d^2y/dt^2 (f : force, m : mass and y : displacement). By combining integrator as shown in the figure and gravity force (f) is applied at the input, speed (dy/dx) is obtained as a negative value of the output of the 1st stage. Further displacement (y) is obtained at the output of the 2nd integrator. The mass (m) is given by the C_1R_1. When S_1 and S_2 are closed the initial speed is set as E_1 on C_1, and initial position E_2 on C_2 respectively. S_1 and S_2 are opened at t=0 and then the time dependent speed and displacement are given.



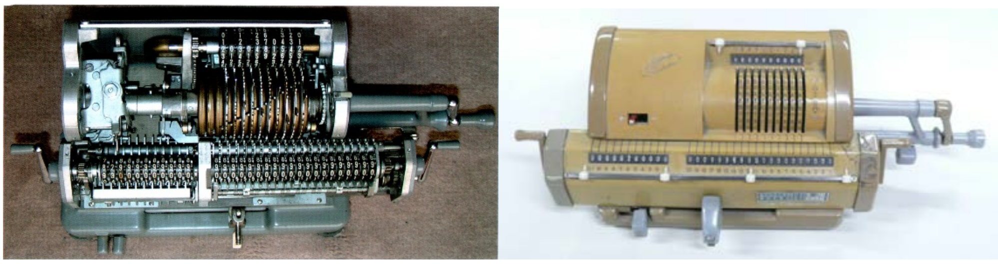
Analog computer

6 Calculator (2) (Digital)

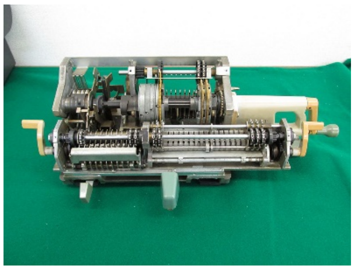


Calculator using gears with steps by Leibniz (around 1700)

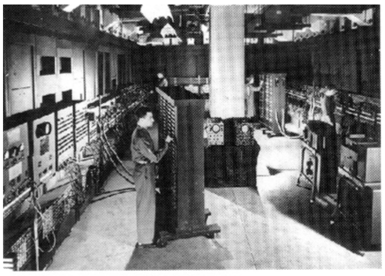
(S.Ohkoma, A history of computer development, Kyoritsu Pub. (2005))



Mechanical digital calculator (around 1960)



Model to show the principle

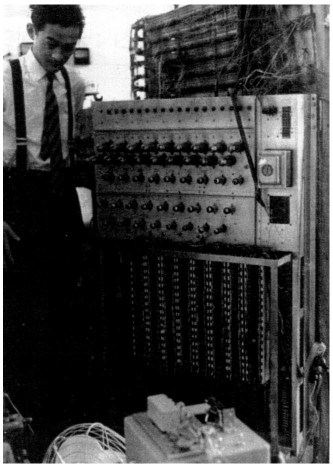


最初のコンピューターとされる「ENIAC」

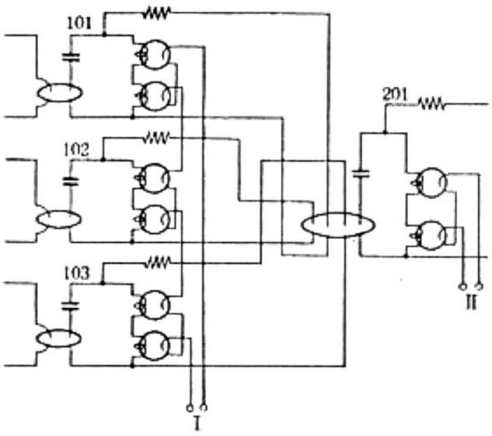
ENIAC (1946)

Transistor calculator (1963)
Hayakawa electric (now Sharp)

Ten key transistor calculator (1964)
Canon “Canola 130”



E.Goto



101	102 Phase	103	Drive to 201	Oscillation phase of 201	
−1	−1	−1	−3k	−1	AND
−1	+1	−1	−1k	−1	
+1	−1	−1	−1k	−1	
+1	+1	−1	+1k	+1	
−1	−1	+1	−1k	−1	OR
−1	+1	+1	+1k	+1	
+1	−1	+1	+1k	+1	
+1	+1	+1	+3k	+1	

Parametron computer (1971)

[1] Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

7 Optical instruments (1) (Camera)

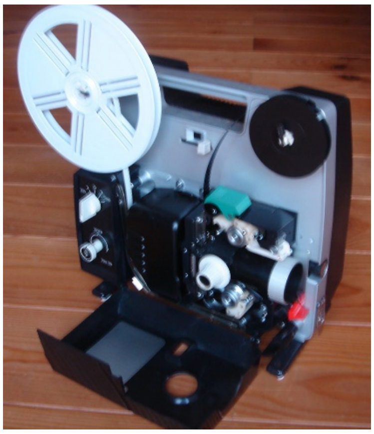
Ricoh 35 lens shutter 35mm film camera (1950's) [1]

Twin-lens reflex camera [2]

Mechanical self-timer for camera[1]

First autofocus camera

Analog recording camera



8mm movie camera and its projector

Digital video camera

[1] Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

[2] Donation by Emeritus Prof. Hiromasa Ito of Tohoku Univ.

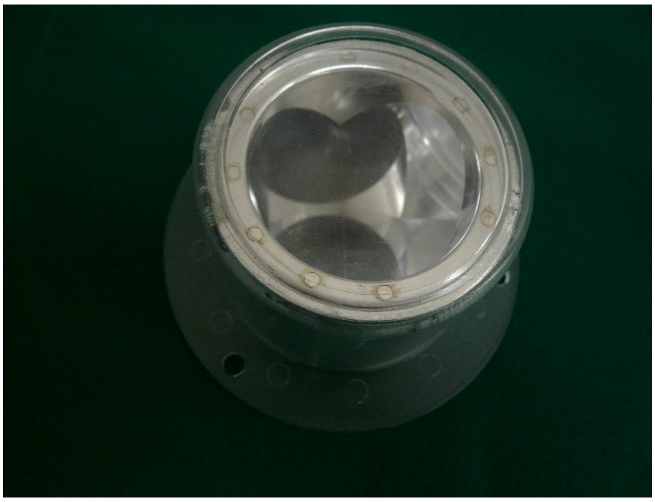
8 Optical instruments (2) (Microscope)

Old biological microscope

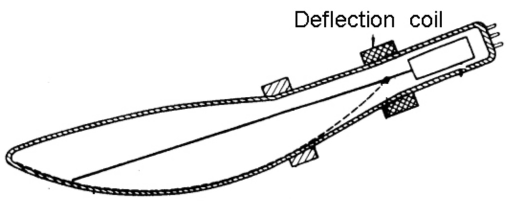
First microscope (replica) (Olympus)

Portable microscope [1]

Telescope (1930s) [1]
(donated by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology)

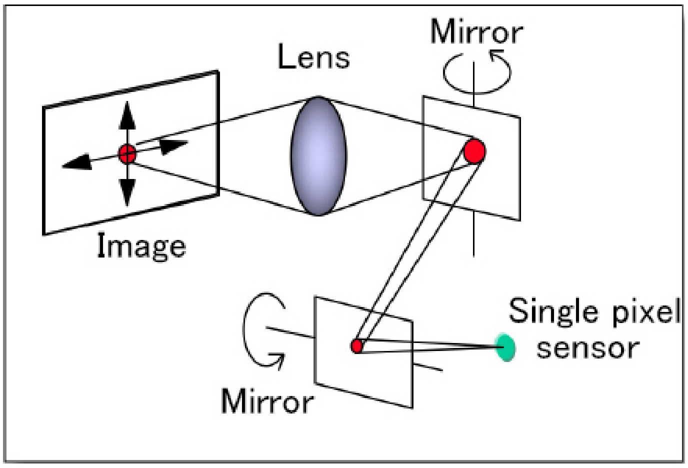


Corner cube



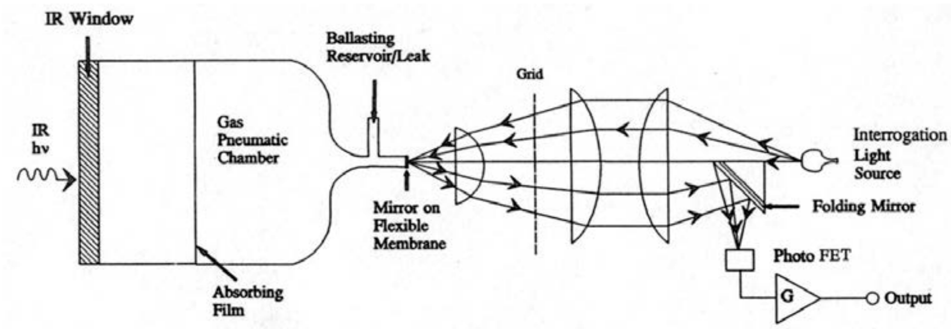
Interphone using flat cathode ray tube (bottom)
(donated by Hiroshi Tanigawa (NEC, Ritsumeikan Univ.)

9 Optical instruments (3) (Infrared measurement)

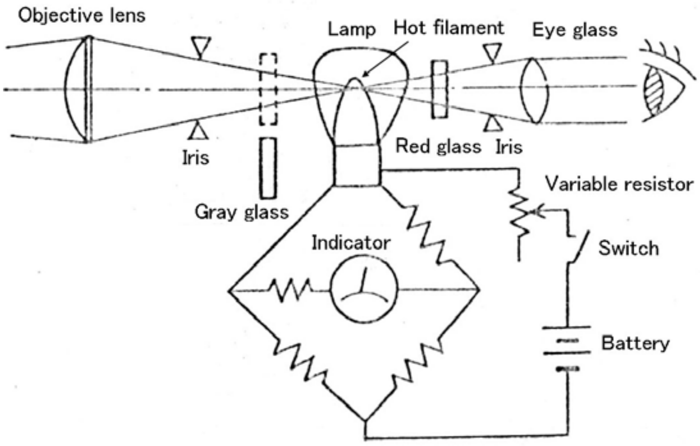


Infrared image is captured by two scanning mirrors and a single pixel sensor

Mechanical scanning infrared imager made in Barnes Company (USA) (donated by Prof. Kimata in Ritsumeikan Univ. ← Prof. Eto in Kinki Univ.)

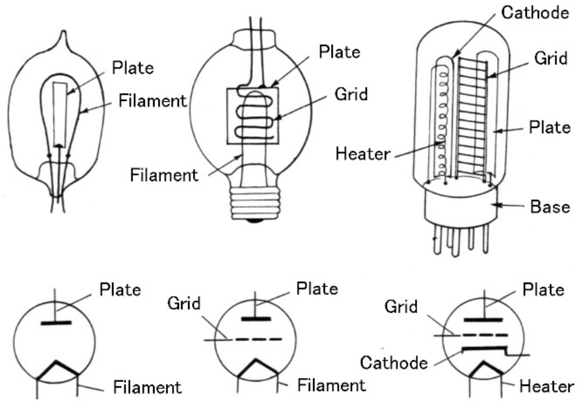


Golay cell (infrared light detector using an expansion of gas)



Radiation temperature meter using diminishing image of hot wire (corridor)

10 Vacuum tube

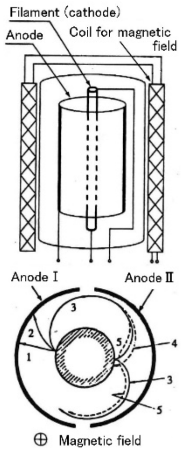


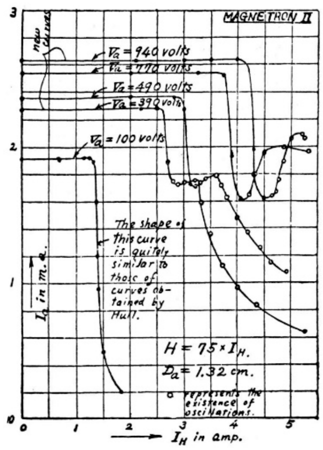
Diode Triode Triode MT tube, GT tube, ST tube, Metal tube, Nuvistor

Fleming (1904) de Forest(1906) (Indirect heating)

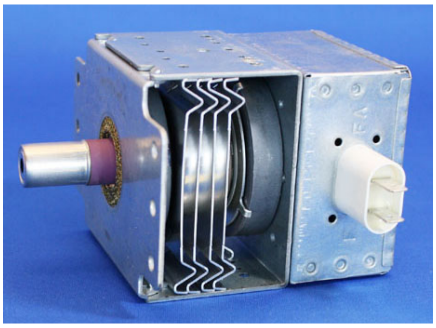
K.Okabe (Tohoku Univ.)

Prototype of split-anode magnetron

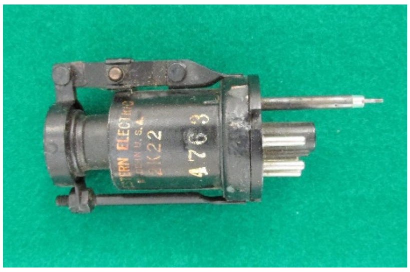




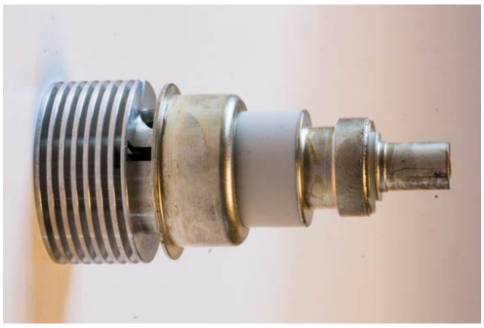
Split-anode magnetron (1932) (History of electronics development (1998))



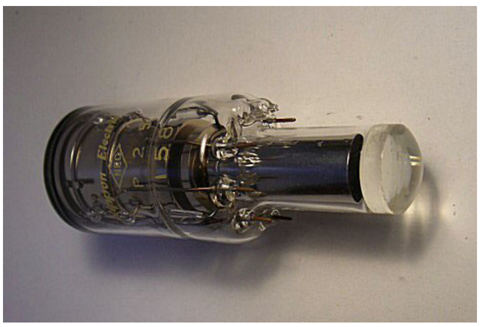
Magnetron for microwave oven



Klystron



Light house tube

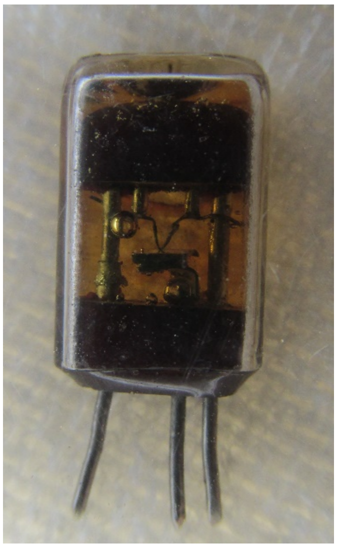


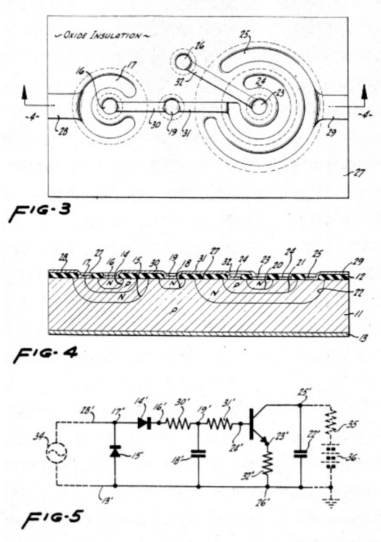
IR image converter tube

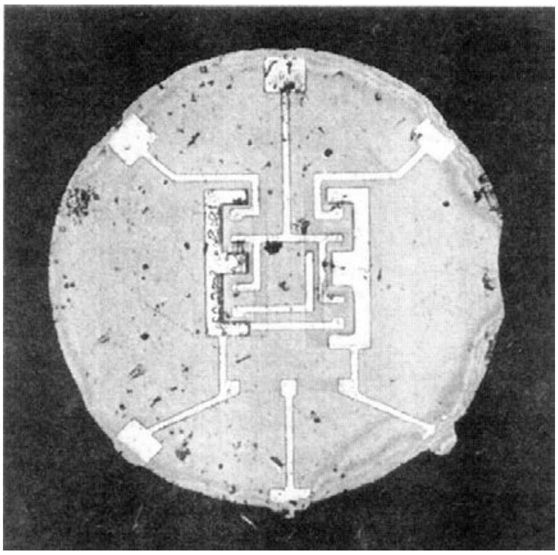
Chalnicon and AP imager (Hamamatsu Photonics)

CRT for oscilloscope

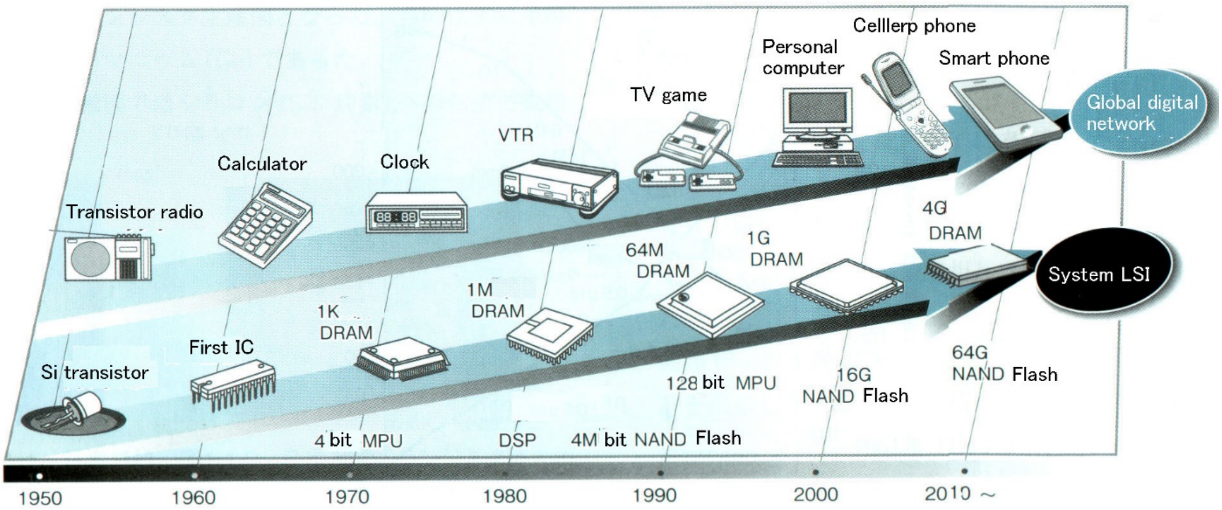
11 Transistor and integrated circuit



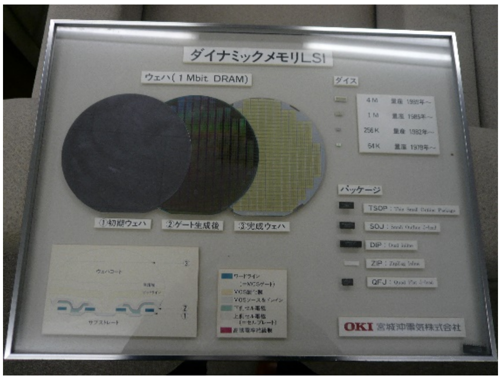


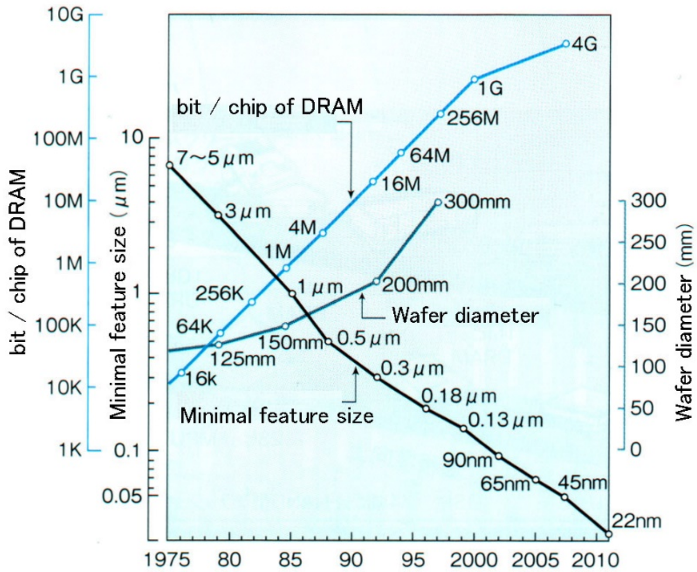


Point contact transistor (1947 Bell Lab.)   Planer integrated circuit (1959 Fairchild)
(Made in Western Electric)



Trend of integrated circuit and home electronics





Development of integrated circuit

(Semiconductor IC Guide Book 2, JEIDA (ed), Industry times (2012))

12 Patrick Haggerty's forecast (1964)

Patrick E. Haggerty (President of TI)

The following paragraphs are reproduced from the book by Patrick E. Haggerty, *Management Philosophies and Practices of Texas Instruments* (Dallas: Texas Instruments, 1965).

BARRIERS TO OVERCOME IN ACHIEVING PERVASIVENESS

Yet, in spite of the pertinence of the knowledge and tools, there have been very fundamental limitations to our applying this knowledge and these tools as broadly as they justify and realizing the inherent power and full pervasiveness of electronics. Some of the most harassing have been:

1. The limitation of reliability
2. The limitation of cost
3. The limitation of complexity
4. The limitation imposed by the specialized character of and relative sophistication of the science, engineering and art of electronics.

BASIC REQUIREMENTS FOR FUTURE SUCCESS

The basic requirements to ensure that electronics enters this terminal phase of pervasiveness, I believe, are threefold:

1. A relatively concentrated, highly automated industrial complex which supplies integrated circuitry and closely related compatible discrete componentry to the rest of the electronics industry and to industry in general must exist. Only a few organizations (perhaps five) will supply 90 percent or more of total industry needs, for this will be a heavily capitalized industry with elaborate computer-controlled processing plants necessary to provide the great flexibility essential to produce the wide variety of integrated circuits needed to fulfill 50 percent or more of all electronic function requirements. In essence, this will be a basic materials segment of the electronics industry with the integrated circuits it produces as the basic materials used by the much larger total electronics industry to satisfy the needs of its customers. In a very real sense (although one must not pursue the analog too far), the integrated circuit producers will be to the rest of the industry as the producers of steel are to the automotive industry, the producers of copper are to the electrical industry, or the producers of aluminum to the myriad of organizations which use that material as a basis for their products.

2. This integrated circuits industry must have established a common language for the input and output parameters which specify its products. It will have created a wide variety of computer programs, which will have replaced conventional engineering handbooks as we know them today and truly allow the user of these basic electronic materials, integrated circuits and compatible discrete components, to design the required electronic functions by the input and output parameters available and specified.

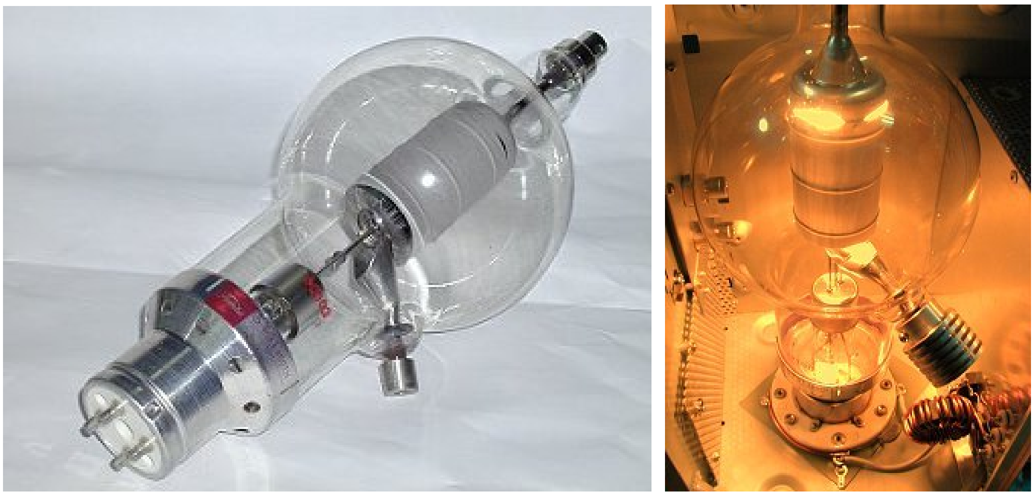
3. A very large number of organizations, probably many more than today, will utilize these basic electronic materials to solve their own and their customers' problems. These organizations will exist in all sectors of our society and will be able to utilize the highly specialized and highly concentrated integrated circuits industry as a substitute for the kind of sophisticated electronics skill described above as the fourth limitation. This will have been made possible by the myriad of computer programs which will allow design by computer through the specification via common language of input and output parameters. A much larger proportion than today of our highly talented electronics engineers will be able to devote their time to the application of electronics to meet the needs of our society rather than to looking inward at electronics itself.

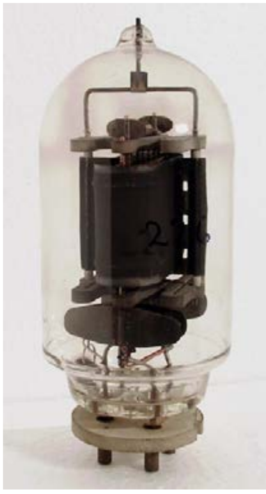
(Seitz & Einspruch, Electronic genie – The tangled history of silicon (1998) Univ.of Illinoiis Press)

13 Large size vacuum tube for transmitter


Triode for transmitter (7T40)


Water cooled triode for transmitter (8T72A))


Triode for transmitter (5T31)


Power triode

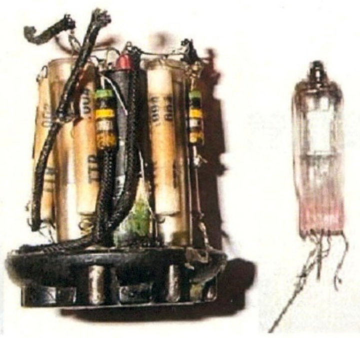

Pontoode for transmitter (4P60)

Pulse modulation tube (3F21P) for radar and sonar

14 Cannonball of anti–aircraft gun using vacuum tube (VT (Variable–Time) fuse)

Cannonball of anti–aircraft gun using vacuum tube (VT (Variable–Time) fuse) was developed during the Pacific war in Johns Hopkins University in United State[1]. When radio waves from the cannon ball are reflected by a target airplane, the reflected radio waves containing frequency difference between transmitted and received waves by Doppler effect are detected. This was detected if the distance between the cannon ball and the target airplane is less than 20m. Interval timer is not necessary and hit rate was improved 20 times.

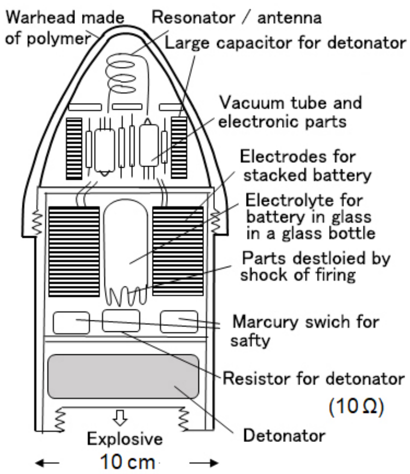
Cannonball of anti–aircraft gun



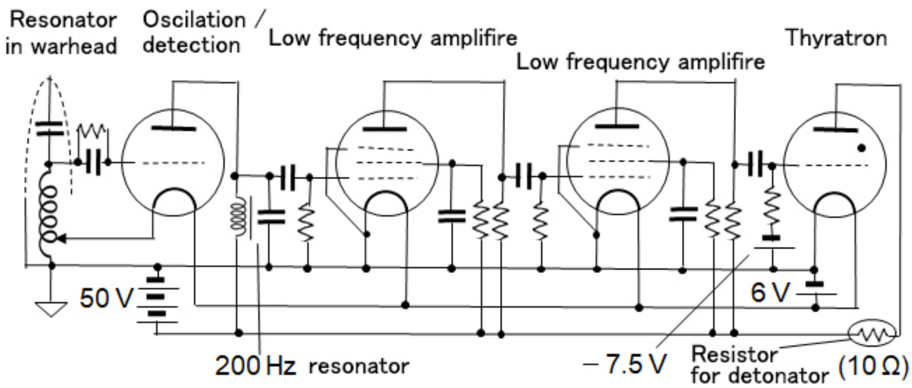
Electronics of VT fuse

Experiment of shot down of aircraft

The structure and circuit of the VT fuse is shown in the following figure[2) 3)]. The transmitter is used as detector as the reflected radio wave and signal of 200 Hz is amplified and trigger a detonator using Thyratron. This has to stand large acceleration (about 10,000 G) and rotation caused by the cannon firing. Subminiature vacuum tube shown in the upper figure and its longitudinal direction is that of travel. Electrolyte for battery is in a glass bottle which is broken by the cannon firing, which is needed for prevent battery discharge and for safety during storage. Since the Battle of the Marianas in June 1944, the VT fuse were equipped in all ships and 2,2 million VT fuse were produced during the second world war[1)]. These were used only in the sea to prevent technology leak by unexploded ordnance, .



Structure



Circuit

1 NHK 取材班編 ："太平洋戦争 日本の敗因 電子兵器 カミカゼを制す", 角川文庫 (1995).
2 貞重孝一 ： 真空管時代のリーディングエッジ電子機器, 映像情報メディア学会誌, **55**, 1 (2001) 70–75.
3 Circuit of VT fuse, http://home.catv.ne.jp/ss/taihoh/vacuumtubes/radar/vtcirct.htm.

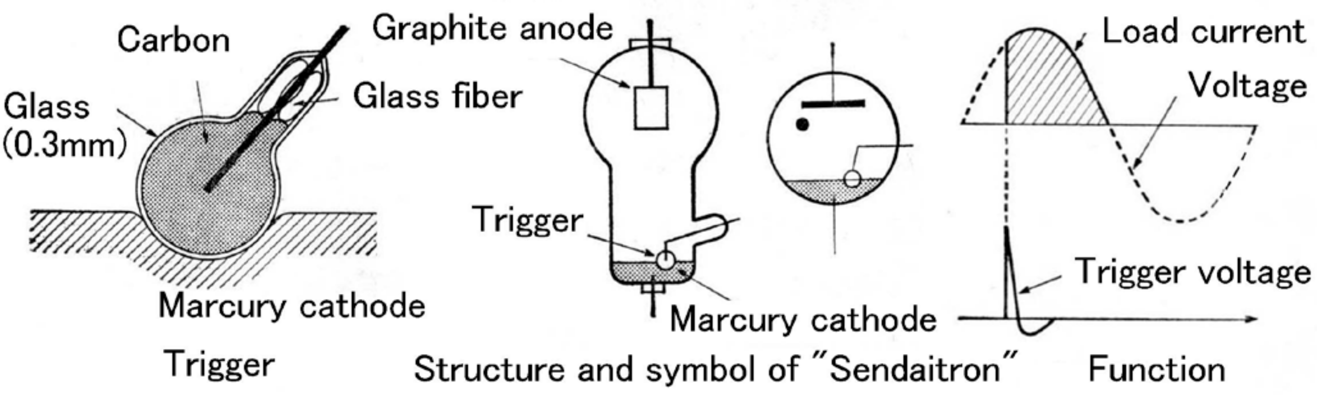
15

From mercury rectifier and thyratron to power semiconductor



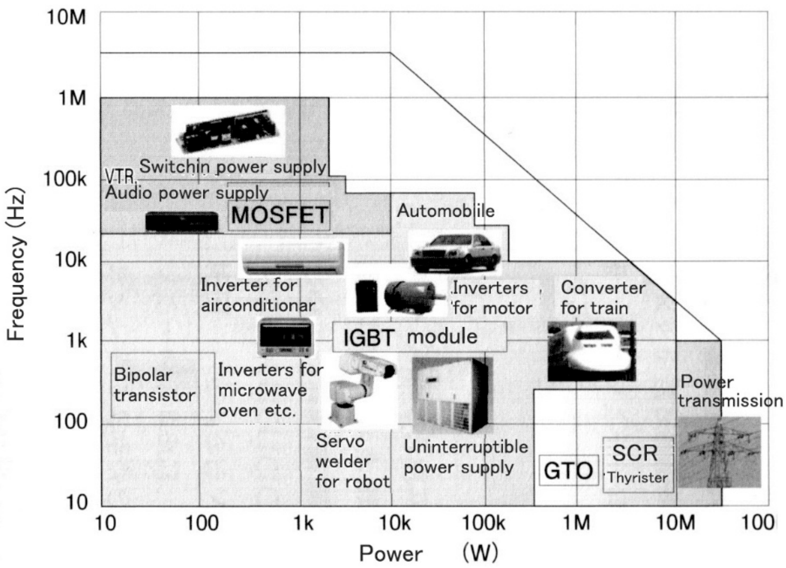


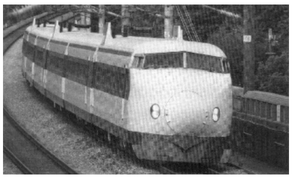
Mercury rectifier 5H69 872A 4H72 2H66 Thyratron(power control) (5G69)



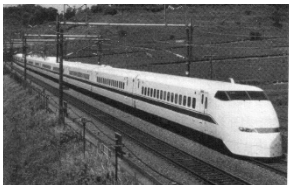
"Sendaitron" (Watanabe, Hatta, Kawai (1949))

GTO：Gate Turn-Off transistor,　IGBT：Insulated Gate Bipolar Transistor

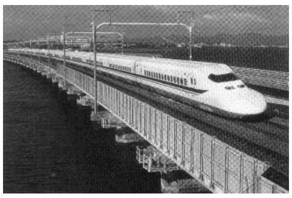




Model 0 系 (1964~)
ダイオード + 変圧器
端子切り替え



Model 300 (1992~)
and Model 500
GTO + PWM
control
electric power
regeneration brake

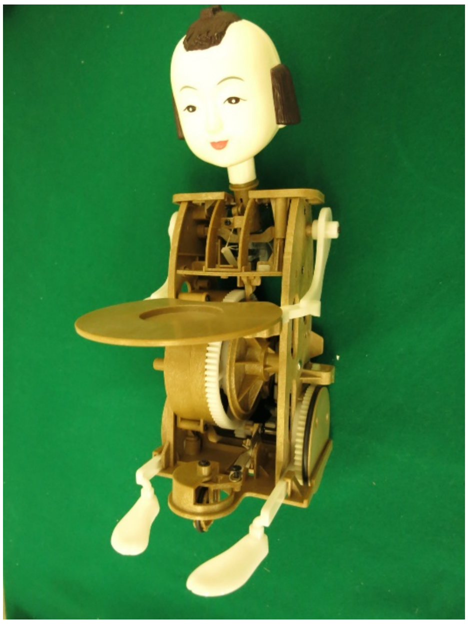


Model 700 (1998~)
IGBT Inverter

Application of power semiconductor categorized by
power and frequency (Power semiconductor influencing the worlds (in Japanese)、J. of IEEJ (2008))

16 Hobby (1) (Robot)

AIBO (Sony)

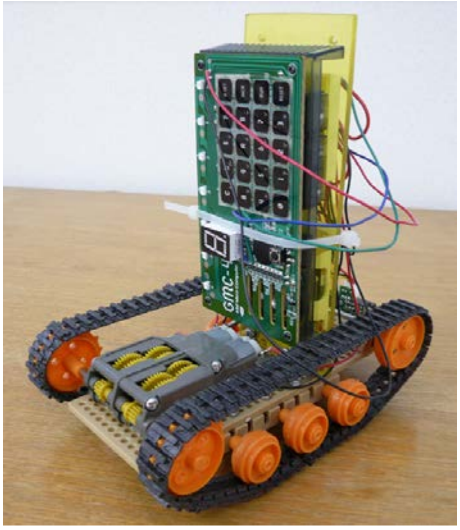


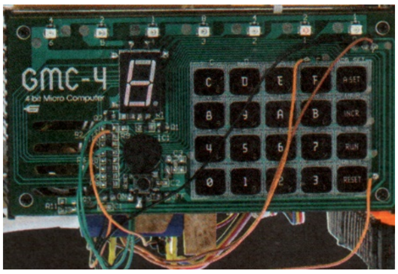
Mechanical doll (Karakuri ningyo) (Gakken)

Small robot

MANOI (Kyosho)

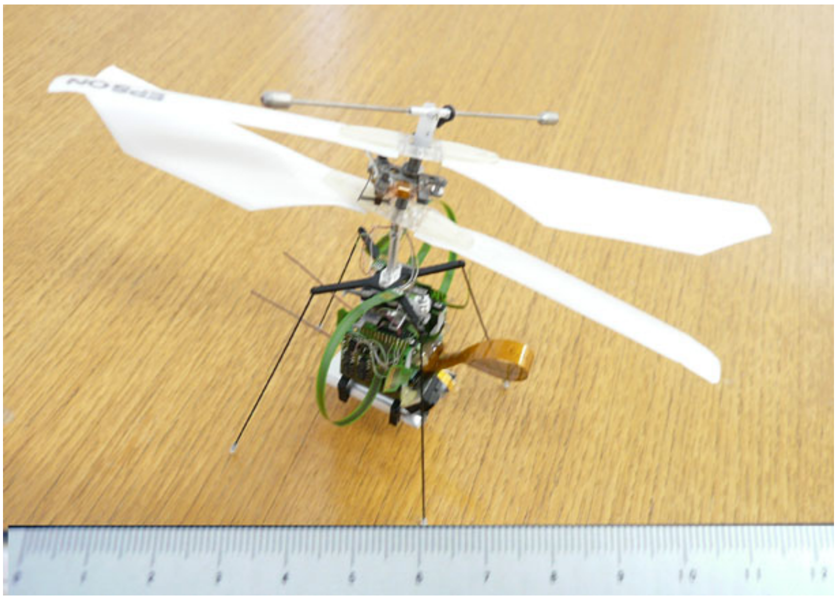
17 Hobby (2) (Car, helicopter)





4bit microcomputer (Gakken) and its application to caterpillar model car

Radio controlled car (Kyence)



Micro fling robot (Seiko Epson)

IR controlled helicopter (CCP)

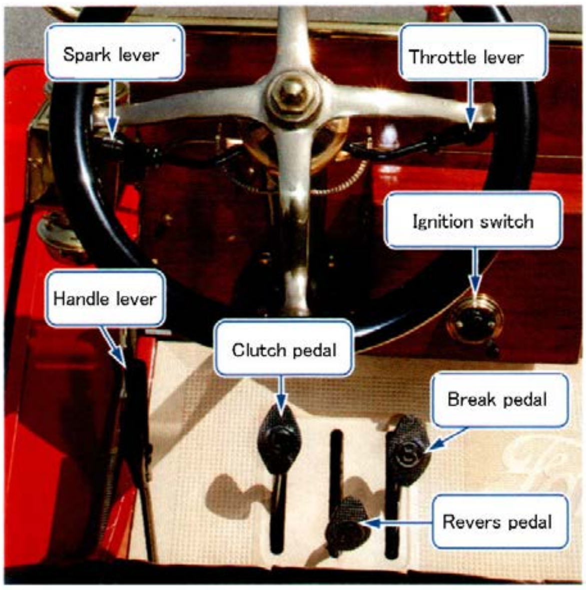
Radio controlled multicopter and helicopter (Keyence)

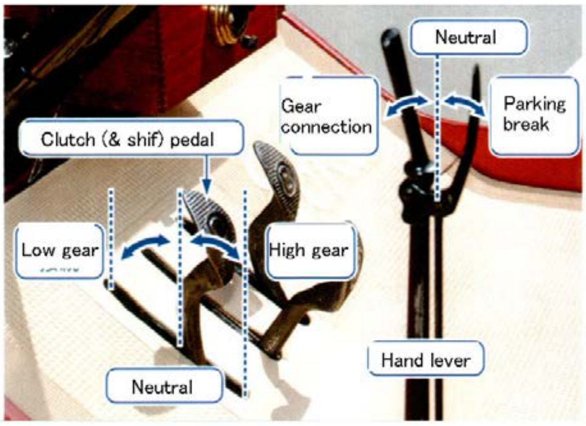
18 Automobile

(Engineering School campus east end)

Model T Ford (1908–1927 15 million cars)

Model A Ford (1927–1931 4 million cars)





Peripheral of handle and pedals of Model T Ford

(Donated by Mr. Masami Tawara (Optoelectronics), Dec. 14, 2005)

19 Illumination and lighter

40W incandescent lamp

40W equivalent fluorescent lamp(8W)

40W equivalent LED(4W)

Current measurement

Air defense incandescent lamp during 2nd world war [1]

At the end stage of the world 2nd war Japan was bombed by US airplane. Dark lamp which illuminate only under the lamp was used for eating and study in order to prevent the light leakage during night. The lamp was made in Matsuda (Toshiba at present). It is 5W for 6–10m^2.

Ignition of lighter and fuel [1]

Lighter initiates from a flint and moxa. The moxa was used as an inflammable. The flint and a cord, the flint and petroleum, platinum black and ethyl alcohol (dangerous), flint and gas. spark by a battery and gas and recently piezoelectric device and gas have been used historically.

The left lighter in the photo was made by Tanita in 1970s. This used the battery and the gas in an expensive Ti case.

The right one in the photo is the flint and the cord. Case and chain are made of silver and this was produced before 1965.

[1] Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

20 Fountain pen

① Mitsukoshi brand（around 1925） syringe and outer lever
② Atena（Maruzen）(around 1925） syringe and outer lever
③ Sheaffer（made in USA）(around 1930）syringe and outer lever
④ Pilot（around 1960）syringe and inner lever
⑤ Pelican（made in Germany） pump
⑥ Montblanc（made in Germany ） pump
⑦ Sheaffer（made in USA）syringe
⑧ Parker（made in USA） A：syringe, B：cartridge pump, C：cartridge
⑨ Parker（made in USA）suction by capillary force

Ink is suctioned using a rubber syringe. The syringe is pushed by pulling up the side lever of the pen. The suction of the syringe is carried out when the side lever returns and syringe inflates（①, ②, ③）. ④ has the lever inside the pen and the lever on the back plays the role.

Later in Germany, the suction is made by a pump (⑤, ⑥). Pump is pushed when the bottom of the pen is twisted and it suctions the ink during returning. The pens are partly transparent and the ink motion can be observed.

The Sheaffer（⑦）made in USA looks like a pump but the structure is the syringe. Bottom is pulled out to push the syringe and pushed back to suction the ink.

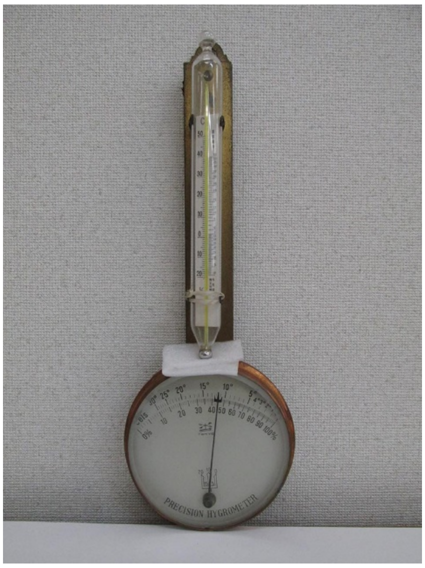
⑧ is Parker made in USA. This is transition from the syringe type to the cartridge. model and 3 suction types can be used. ⑧A is the syringe type, ⑧B is the cartridge pump type and ⑧C is the cartridge type.

⑨ is also Parker made in USA, but it use new suction by capillary force. This had a problem to reduce suction volume in long use and the pen shifted to the cartridge type.

Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

21 Measurement gauge

Balance [1]



Hear hygrometer with thermometer [1]

Maximum minimum thermometer [1]

Fare and rain meter (around 1925) [1]

Portable magnetic compass [1]

Pedometer (1930!’s USA) [1]

The weather is visible in the left glass tube.
The liquid inside crystalize depending on the weather.

Proportional compass [1]

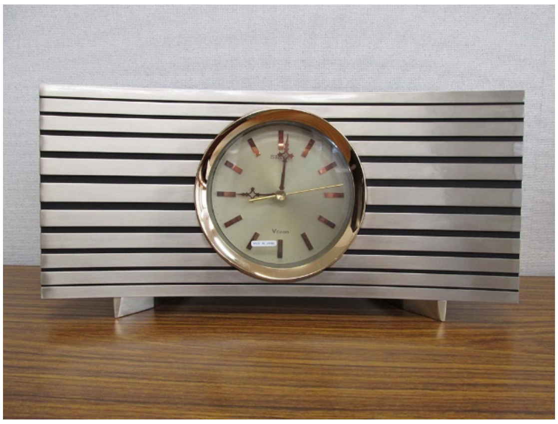
Planimeter (measurement of area)

{1} Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

22 Clock

Mechanical discharge lamp display clock driven by AC motor
(1970 Tamura) [1]

Clock driven by electrical motor
(Tokyo clock) [1]

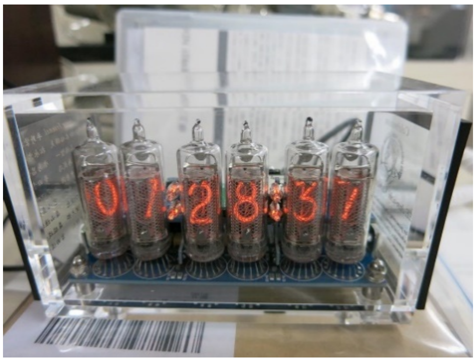


Tuning fork clock (1974 Seiko) [1]

Tuning fork watch (1960 Bulova Accutron (Switzerland) [2]

Graphic clock
(1985 Citizen) [1]

Pendant quartz watch
(1979Sharp) [1]



Nixy tube clock (with GPS)
(2015 年 Charonix Design Works)

[1] Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology
[2] Donation by Mr.Yutaka Kojima in Kojundo Chemical Laboratory

23 Typewriter

Portable typewriter (Before the second world war) [1]
(Prof. Shigeto Tsuru who was a president of Hitotsubashi Univ. used it in Harverd Univ..)

Electrical typewriter (Corona) [1] (Prof. Shigeto Tsuru who was a president of Hitotsubashi Univ. used it.)

[1] Donation by Emeritus Prof. Yakichi Higo of Tokyo Institute of Technology

「世界一の町工場」と呼ばれる清田製作所

世界 最小の道具を 最高の技術で 一位の町工場

半導体プローブ

1000分の1の精度

従業員十数人

トップ直撃

清田製作所 清田茂男社長(85)

「小さな巨人」の異名をとる半導体プローブ（検査針）のトップメーカー、清田製作所。半導体プローブとは、半導体に電流が正常に流れるかどうかを調べる道具で、1000分の1の精度が求められる。これまでその域に達することができたのは、清田茂男社長を含めて世界で2人。発明大賞など数々の賞に輝く業界の有名人でもある。

【会社メモ】1963年創業。本社・東京都北区。プレス加工によるカメラ・電機通信部品等の製造業でスタートし、82年、電子部門に進出、電子デバイス検査用コンタクトプローブの研究を始めた。86年、国産初シリコンウエハー用4探針プローブの開発に成功し、発展の基盤をつくる。資本金600万円、売上高約1億4000万円（2012年5月期）。従業員16人と社の規模は小さいものの、技術力の高さから「世界一の町工場」と呼ばれる。

Evening Newspaper Fuji 2013/1/29

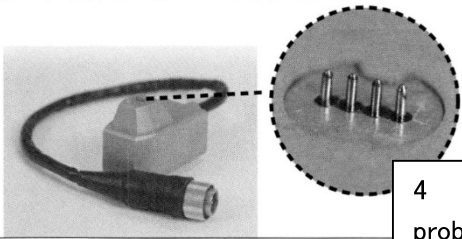
特殊コンタクトプローブ

平成7年4月

科学技術庁長官賞「科学技術振興功績賞」受賞

ケルビン4探針プローブ

昭和61年製品化に成功。世界で2名だけの開発製品

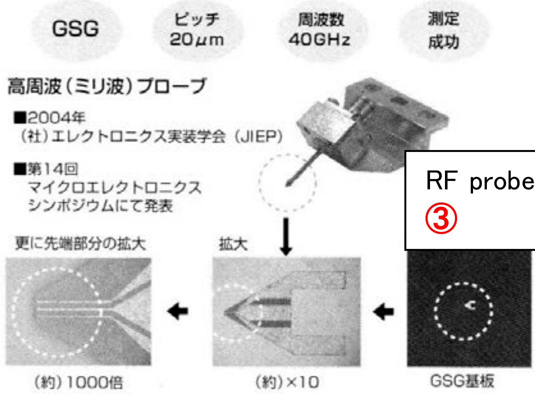


Recording stylus ①

4 point probe ②

Spring probe ④

「産・学・官」連携開発製品

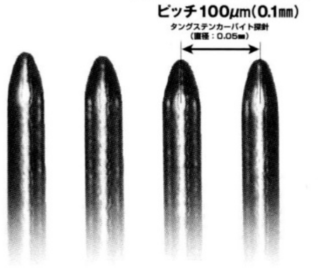


RF probe ③

Stacked probe ⑤

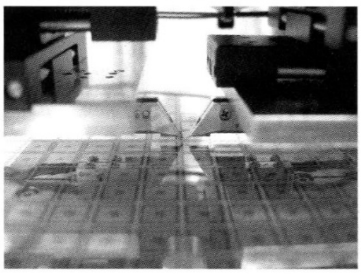
キヨタ、NTT-AT共同開発製品世界初！

ケルビン100μm4探針プローブ



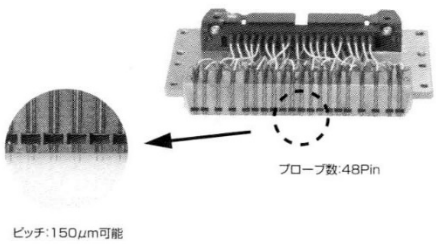
慶應大学、産総研の協力による産学官連携で成功。積層型技術と四探針技術の複合化で実現。

積層型プローブ搭載測定治具

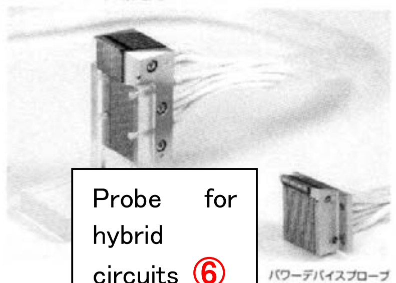


●ファインピッチ/高電流対応可能

ハードディスク GMR磁気ヘッド対応プローブ



ハイブリッド車用開発プローブ



Probe for hybrid circuits ⑥

第1章 現代日本の諸課題 6

このテーマに関係する本教科書のページ p96,p102

飛び出せ中小企業!!

産業構造の変化と中小企業

日本には500万社以上の中小企業があり、そこでは約4,500万人の人が働いている(いずれも1999年)。そのなかには町工場もあれば、商店街の鮮魚店、クリーニング店もある。創業以来数百年を数える老舗もあれば、独創的な技術・サービスに取りくむベンチャー企業もある。

中小企業は単独で活動することは少なく、地場産業、大企業の下請け、商店街など多くの企業との連携によって経営を維持していることが多い。これらの企業の活動は国民生活に密接に結びついているものが多く、日本経済の基礎を形成する重要な存在として評価されている。

日本の中小企業には、大企業との賃金や労働条件の格差、市場での競争力の弱さなどの問題点が指摘されている。しかしその一方で、世界的にみてもトップレベルの技術力をもつ企業も多数現れている。

小さな世界企業 東京都北区にある清田製作所は従業員数19人の小さな町工場である。しかし、この工場に世界の名だたる半導体メーカーの技術者たちが頻繁に訪れ、社長の清田氏に相談をもちかけている。この会社がつくっているのは、コンタクトプローブ(接触型探針)という製品で、半導体集積回路の製品が正しくつくられているかどうかを検査するときになくてはならない重要な測定器具である。

このプローブの先端は1マイクロメートル以下という細いもので、肉眼で確認することはできない。世界中で清田氏以外にこの製品がつくれるのはイギリスに1人しかいないという。半導体メーカーは、新しい集積回路をつくるときに、コンタクトプローブがつくれるかどうかを清田氏に相談に来る。それは集積度が上がるほど端子間の間隔が細くなるので、従来より細い針がつくれるかどうかが製品開発の鍵を握っているからである。

産業構造の変化にたくみに適応 清田氏は小さなプレス工場を経営しながら時代の変化に敏感に対応してさまざまなものをつくってきた。彼がこれまでに手がけた製品をみると、ハーモニカ(雑貨)、カメラの露出計やレコード針(精密機器)、半導体検査針(電子機器)とそのときどきの産業構造の変化に柔軟に対応しながら企業を変化させてきたことがわかる。日本の中小企業のなかには清田氏と同じように、産業構造の変化にうまく適応しながら、新分野に進出し、かつ技術力を向上させてきた企業が多い。日本の製造業は、こうした中小企業で働く人々のたゆまぬ努力によって支えられてきたのである。

中小企業政策の転換 中小企業はこれまで大企業にくらべて弱者としてとらえられ、政府もこうした格差の是正を政策の柱にしてきた。しかし清田氏の例をみても明らかなように、多くの中小企業はみずからの力で経済の変化に対応し、その姿を変えながらレベルを向上させてきた。一方、近年の経済の停滞などにより新規開業をする企業が減少し、企業数が全体として減ってきている。このような中小企業を取り巻く環境変化を踏まえて、政府は1999年に中小企業基本法を改正し、新規開業の促進や成長性のある企業を伸ばす政策に転換している。

売上高営業利益率別の企業割合(「中小企業白書」)

製造業の事業所数(「中小企業白書」)

年	事業所数
1997	358,246
1998	373,713
1999	345,457
2000	341,421
2001	316,179

▲針金のように細い金属の管 針金を通して管の中を掃除する。

▲清田製作所の作業所 わずかなスペースにローテクな機械が配置されているが、ここでつくられた製品はハイテク産業で使用されている。

◀自社の製品を前に語る清田氏

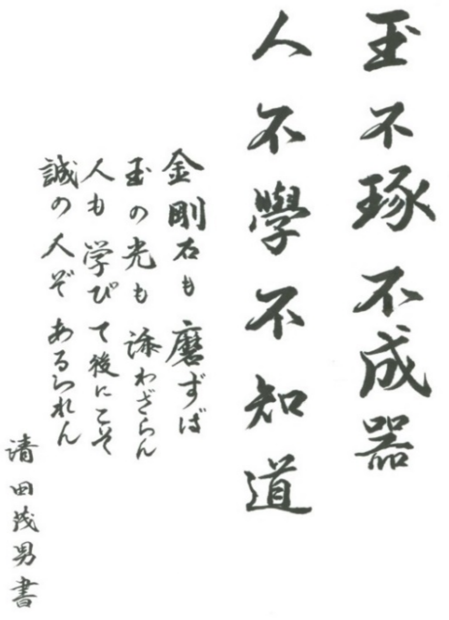
▲清田製作所でつくられているコンタクトプローブの部材 初期(左)のものに比べて小さく細くなり技術が高まっている。

課題と考察

1 地域の中小企業のデータを調べよう。
自分たちが暮らす市区町村などの行政機関に行って、その地域の中小企業の現状について調べてみよう。調査する場合の項目としては、業種ごとの企業数、従業者数、年間の売上高などがある。それらのデータを過去とくらべてどのように変化しているかを考察することも必要である。

2 ユニークな企業を探そう。
自治体や商工会議所に行って、その地域で特徴ある経営をおこなっている企業を紹介してもらい、そこで下記のような質問をしてみよう。
①創立年と創業者の名前、②おもな製品(過去と現在)、③おもな顧客(取引先)、④同業他社の数とその企業の業界内の地位、⑤その企業の強さはどこにあるのか、など。

174 現代日本の諸課題



【平成7年】田中真紀子科学技術庁長官(中央)と共に

渋沢史料館にて

Kiyota Magfacturing Co. was closed on May 31, 2014 after 50 years operation. All employees and facilities were moved to its contract manufacturing company and "Kiyota probes" have been manufactured there. Kiyota's technologies are expected to contribute for the future of electronics.