Medical and Biological Engineering

From Ideas to Successful Medical Products

Content

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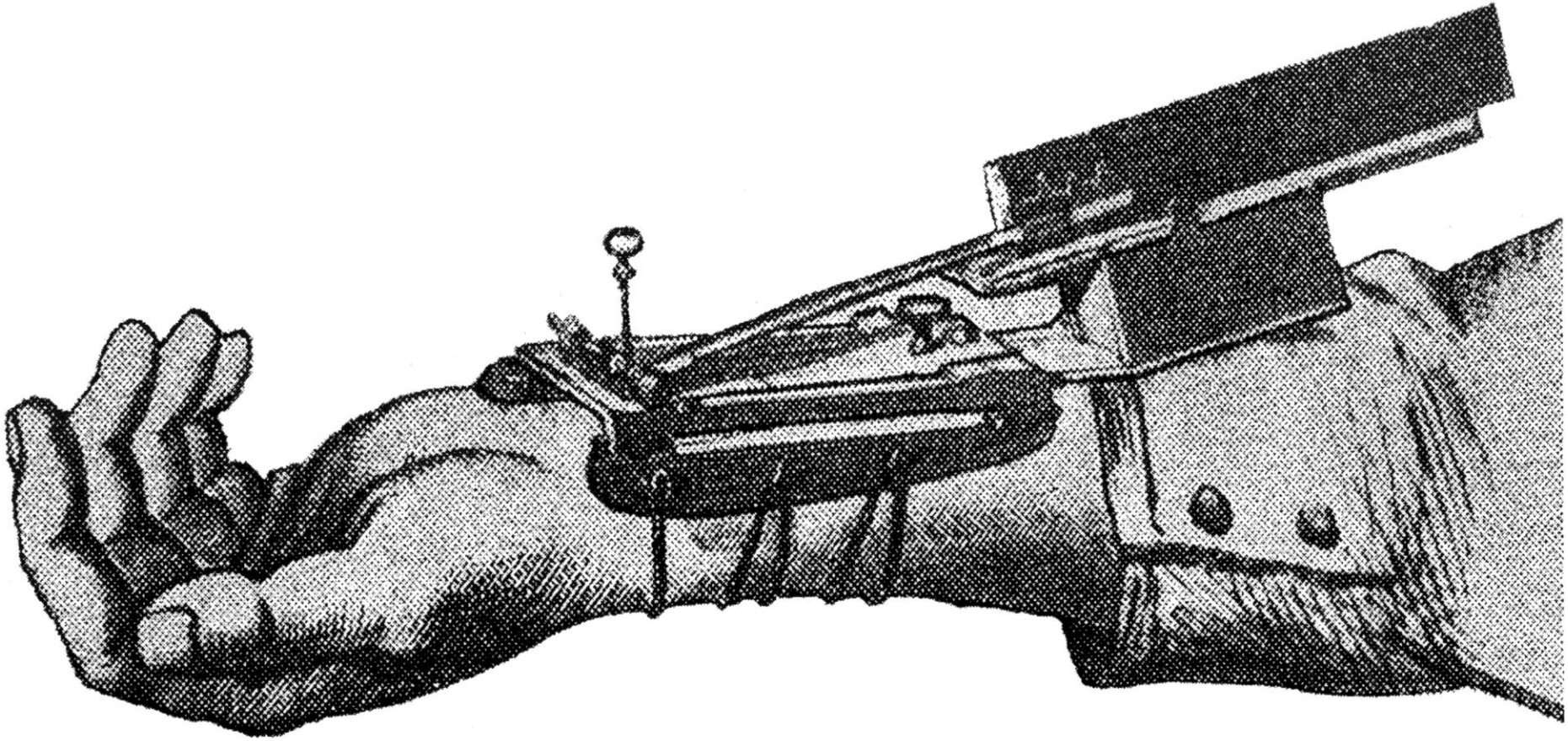
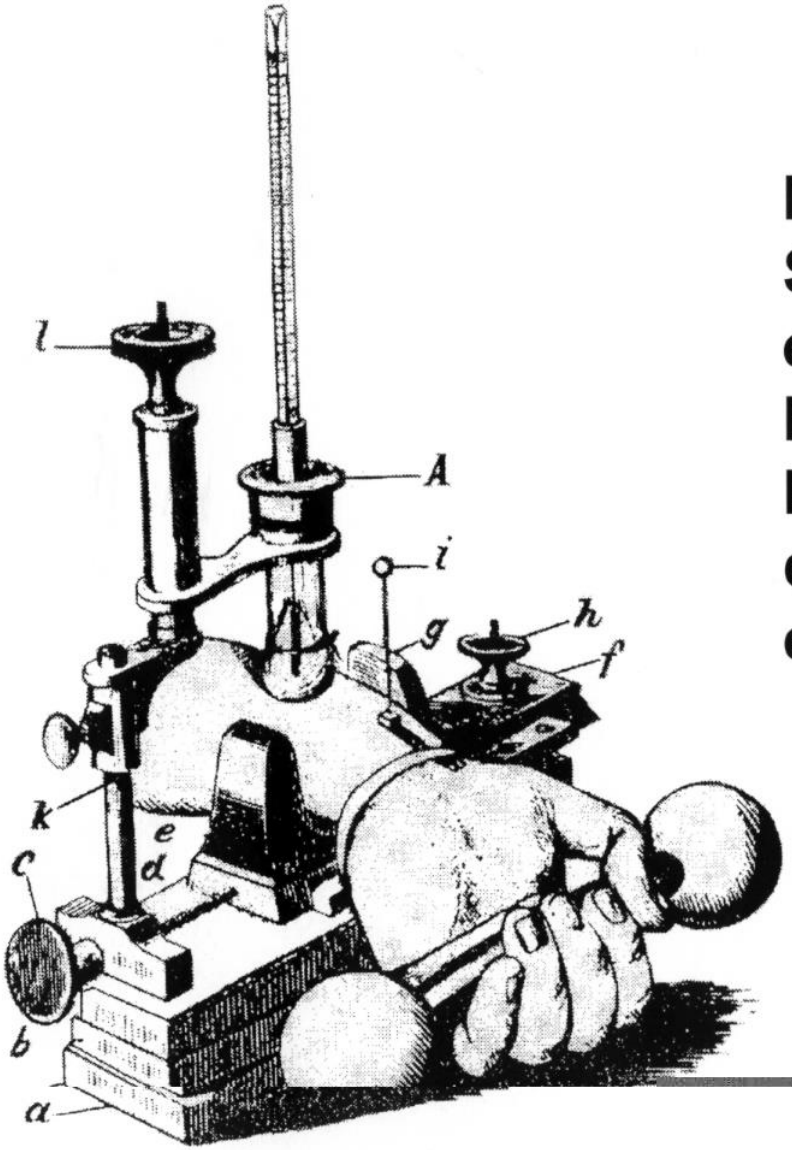
Direct measurement of the arterial blood pressure by St. Hales (1726)

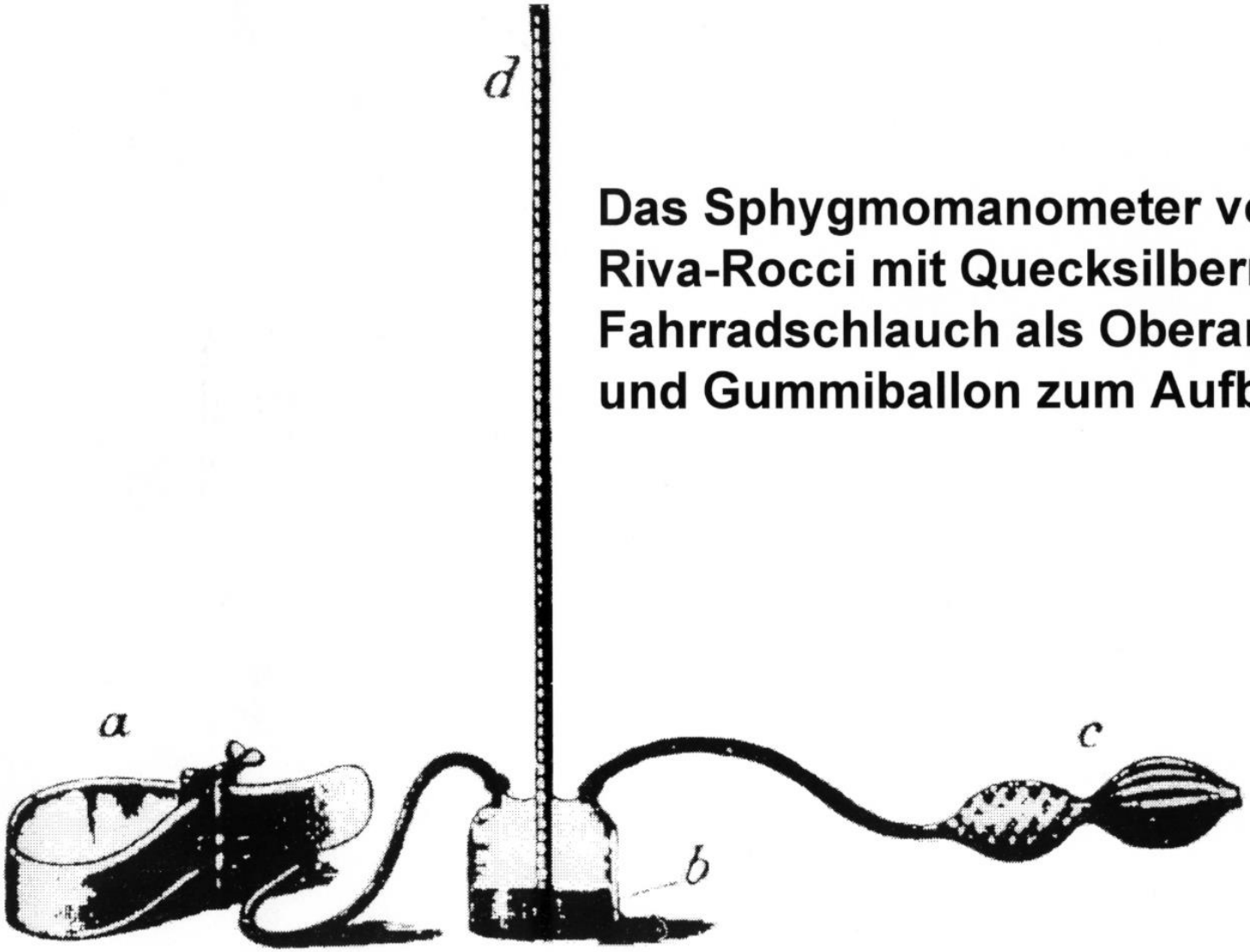


Arterial pulse-recorder by E-J. Marey (about 1860). The pulse oscillations are increased by a lever and recorded on a moving sooty plate.



Das Sphygmomanometer von Samuel Ritter von Basch, das ein Vorläufer des Modells von Riva-Rocci darstellte.
Ein wassergefüllter Ball übertrug die Pulsdruckschwankungen auf ein Quecksilbermanometer.

Arterial pulse monitor with mercury in a sac and capillary as monitor for the pulse oscillations, developed by S. von Basch (1880)



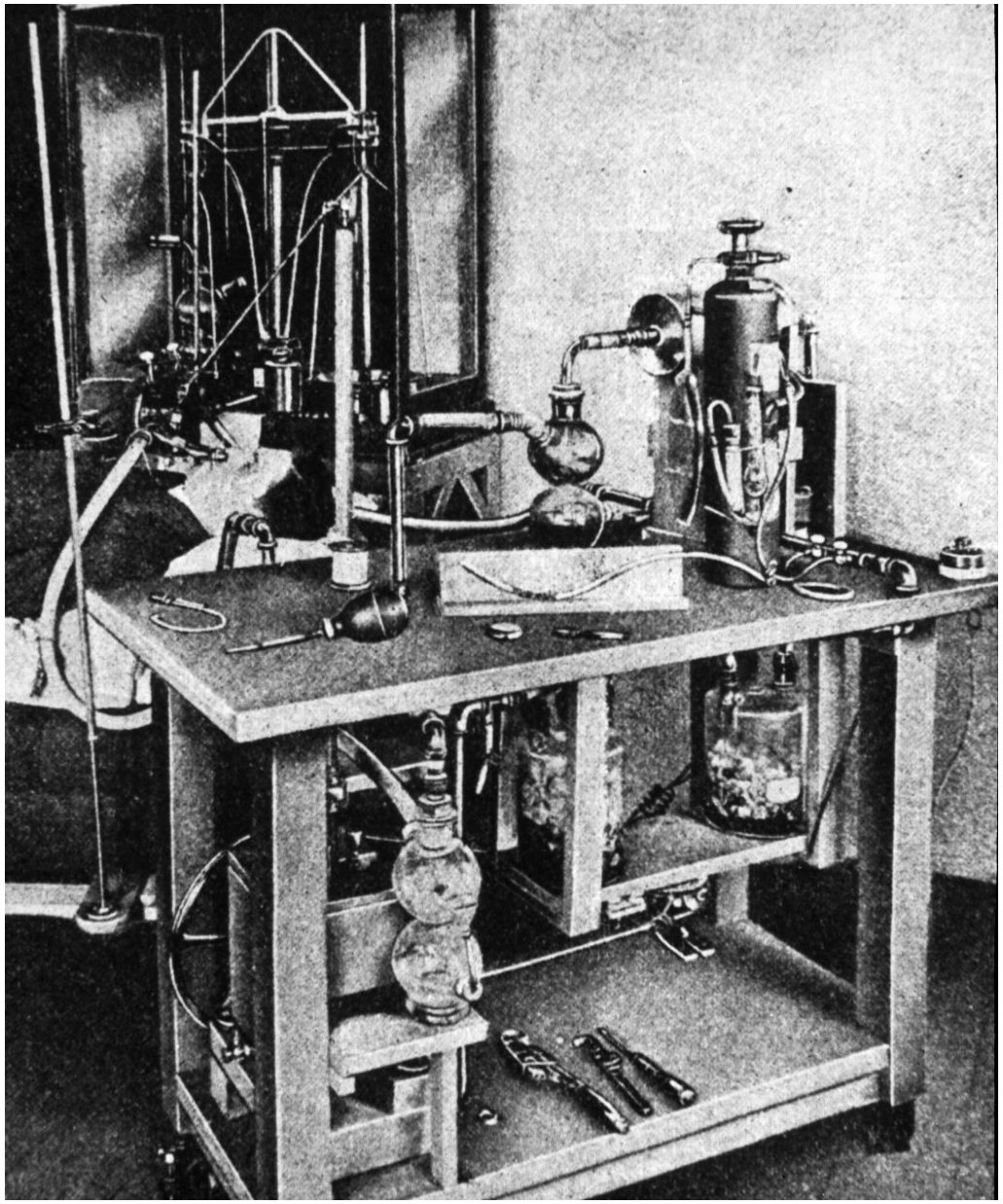
Das Sphygmomanometer von Riva-Rocci mit Quecksilbermanometer, Fahrradschlauch als Oberarmmanschette und Gummiballon zum Aufblasen.

Original device developed by S. Riva-Rocci for blood-pressure measurement in 1896

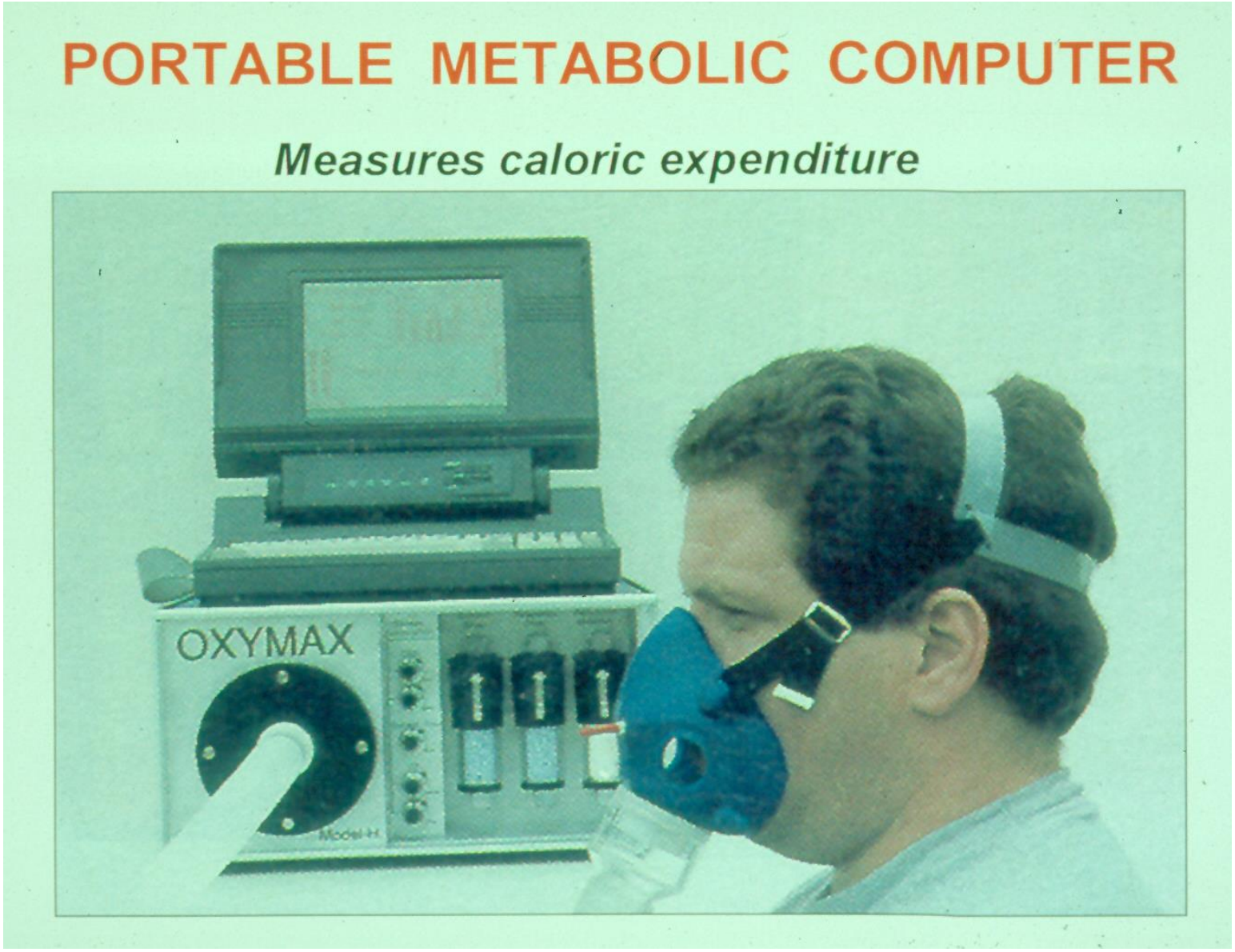
Classical Riva-Rocci-devices for arterial blood pressure measurement

Automatized measurement of the arterial blood pressure at the wrist

Basic metabolic research (Santorio Santorino, 1614). The test person was sitting for months on a balanced scale.

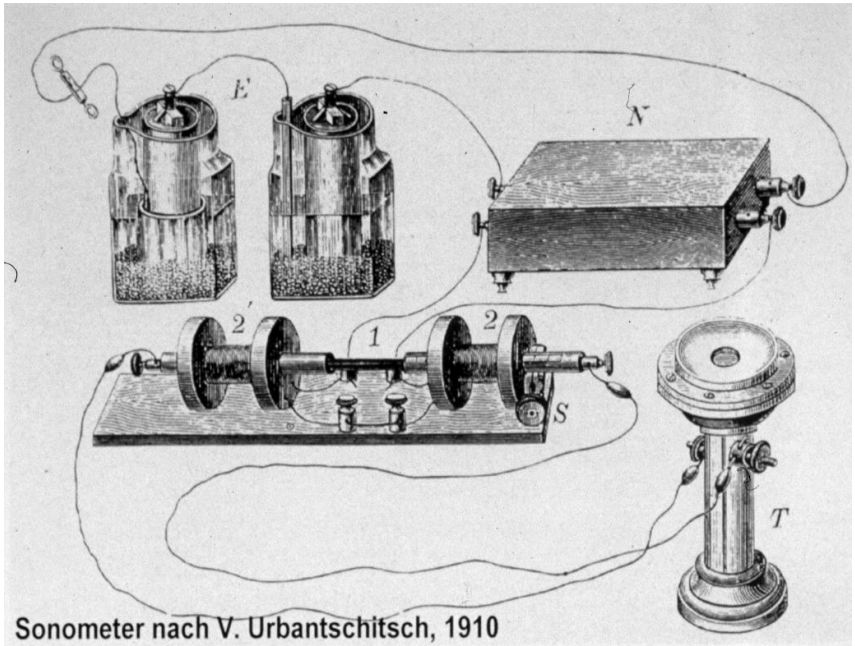


Workplace for metabolic measurements (F.G. Benedict, 1909)



Portable device for measuring oxygen consumption and calculating metabolism

Whole-body plethysmograph for lung function testing (Jaeger 1990)

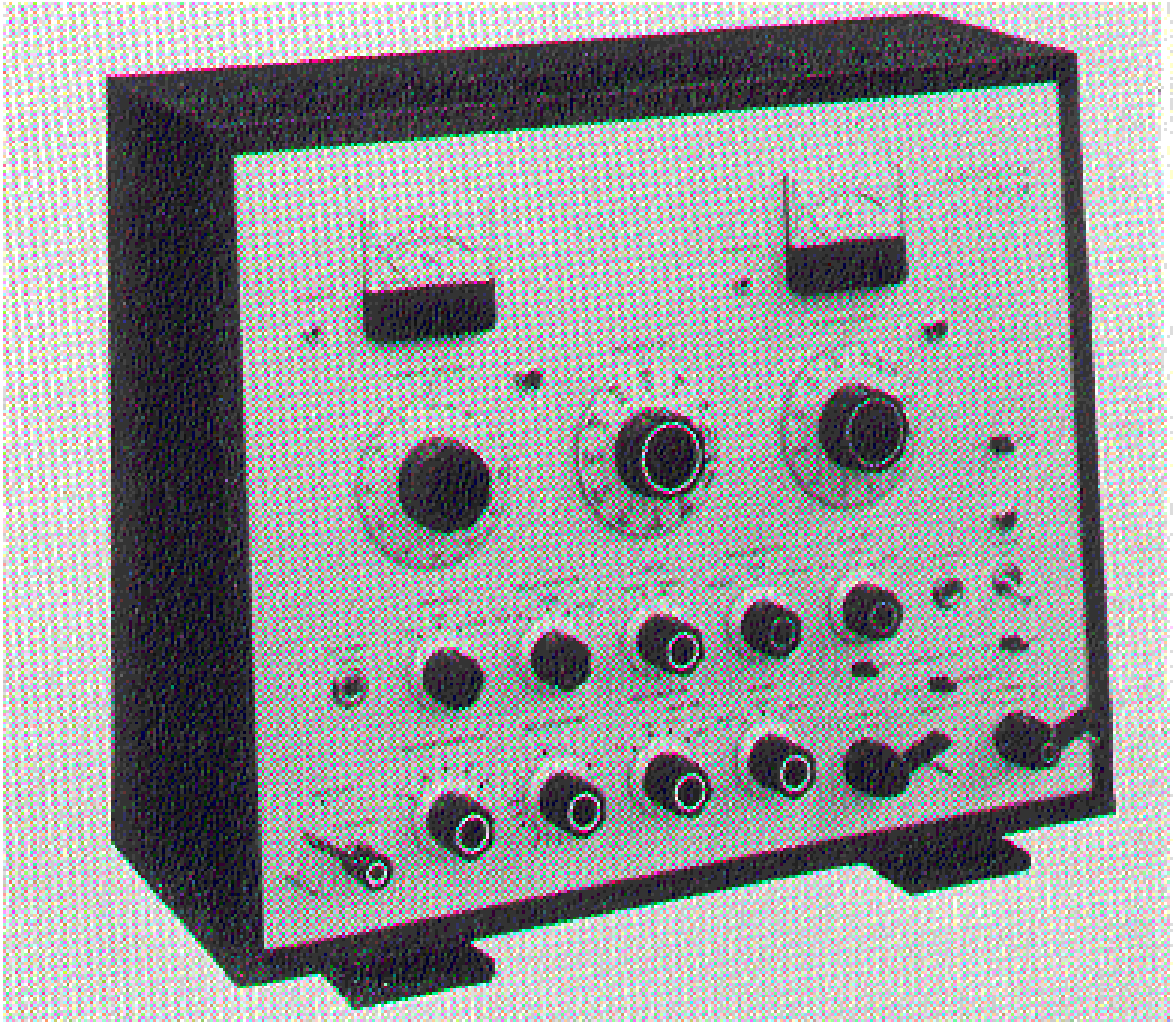


Sonometer nach V. Urbantschitsch, 1910

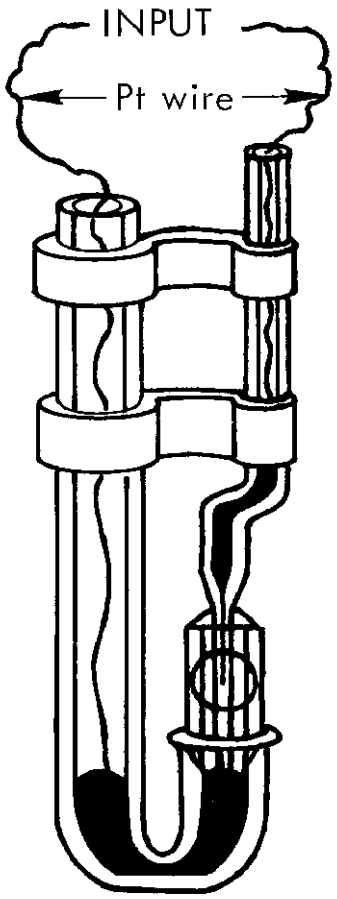
Hörprüfgerät, Vorläufer der heutigen Apparate.
E = Stromquelle, in diesem Fall Leclanché-Elemente
N = Stromunterbrecher, Neefscher Hammer zur Geräuschdämpfung in einem Kasten untergebracht
T = Telefonhörer
2 = feststehende Spule
1 = verschiebbare Spule
S = Stellschraube zur Verschiebung der Spule1 gegenüber Spule2

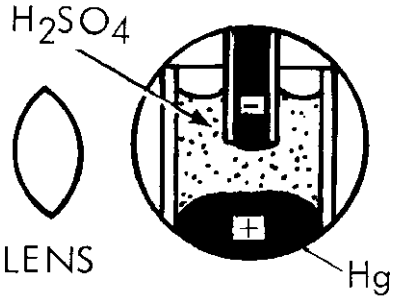
Dadurch ausgelöste Induktionsströme werden über das Telefon in Geräusche umgesetzt, deren Intensität somit meßbar ist.

Sonometer (audiometer), i.e. measuring device for hearing defects, battery-powered and provided with a telephone loudspeaker (1910)



Audiometer clinical testing (1973)

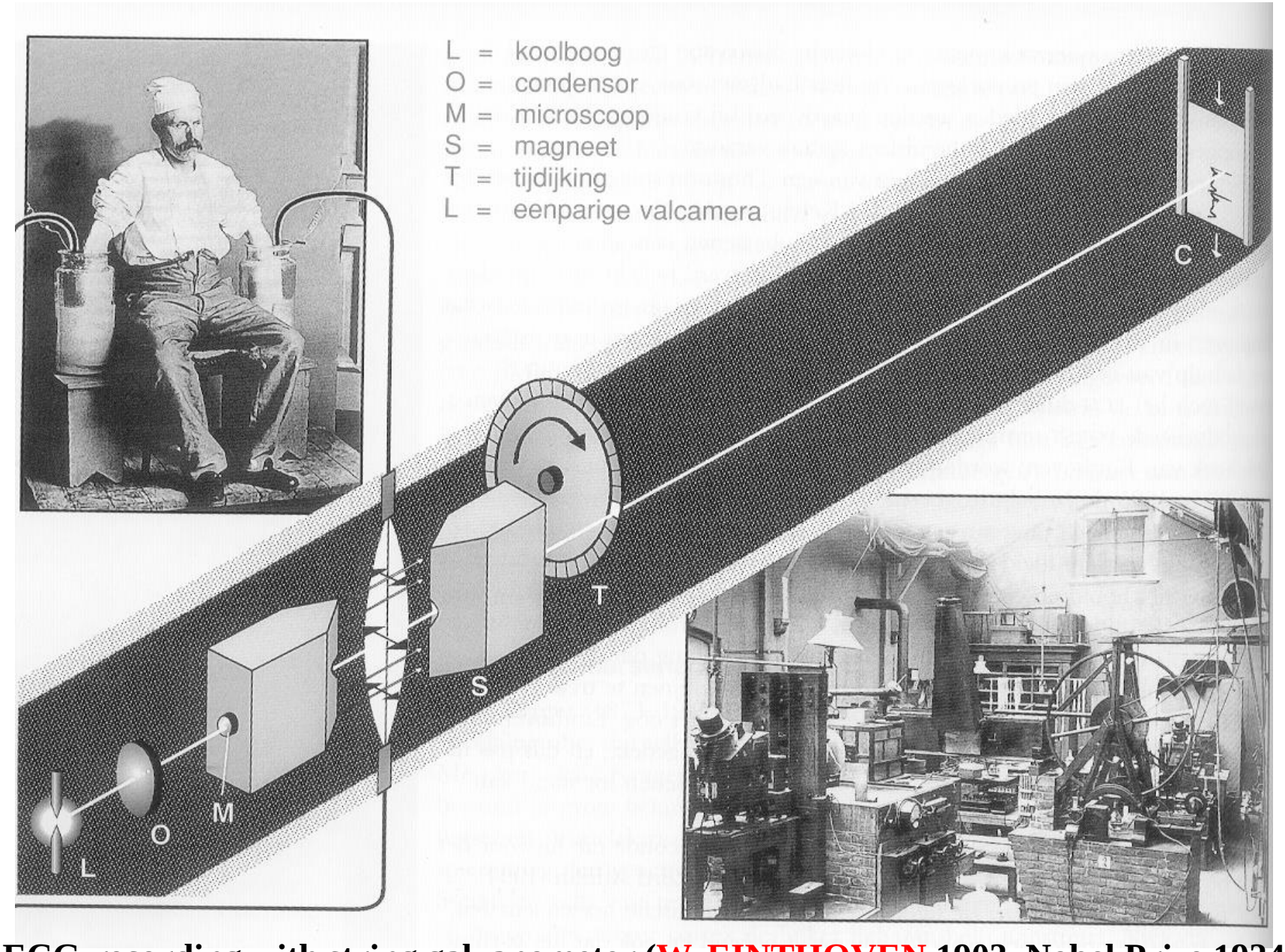




Capillary electrometer invented by

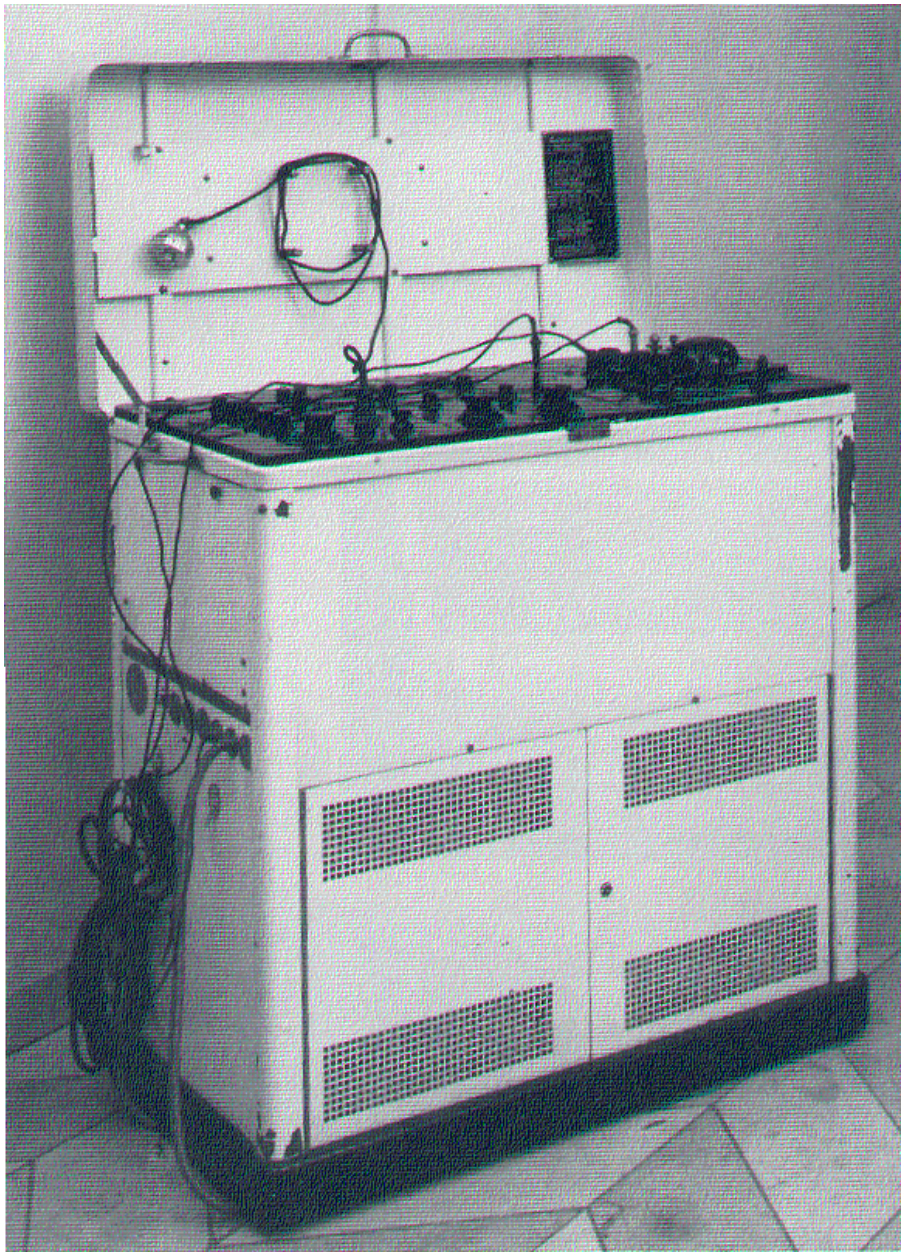
G. Lippmann (about 1875)

Acquisition and monitoring of the electrocardiogram with a capillary electrometer (filled with mercury) before W. Einthoven by A.D. Waller (1887)



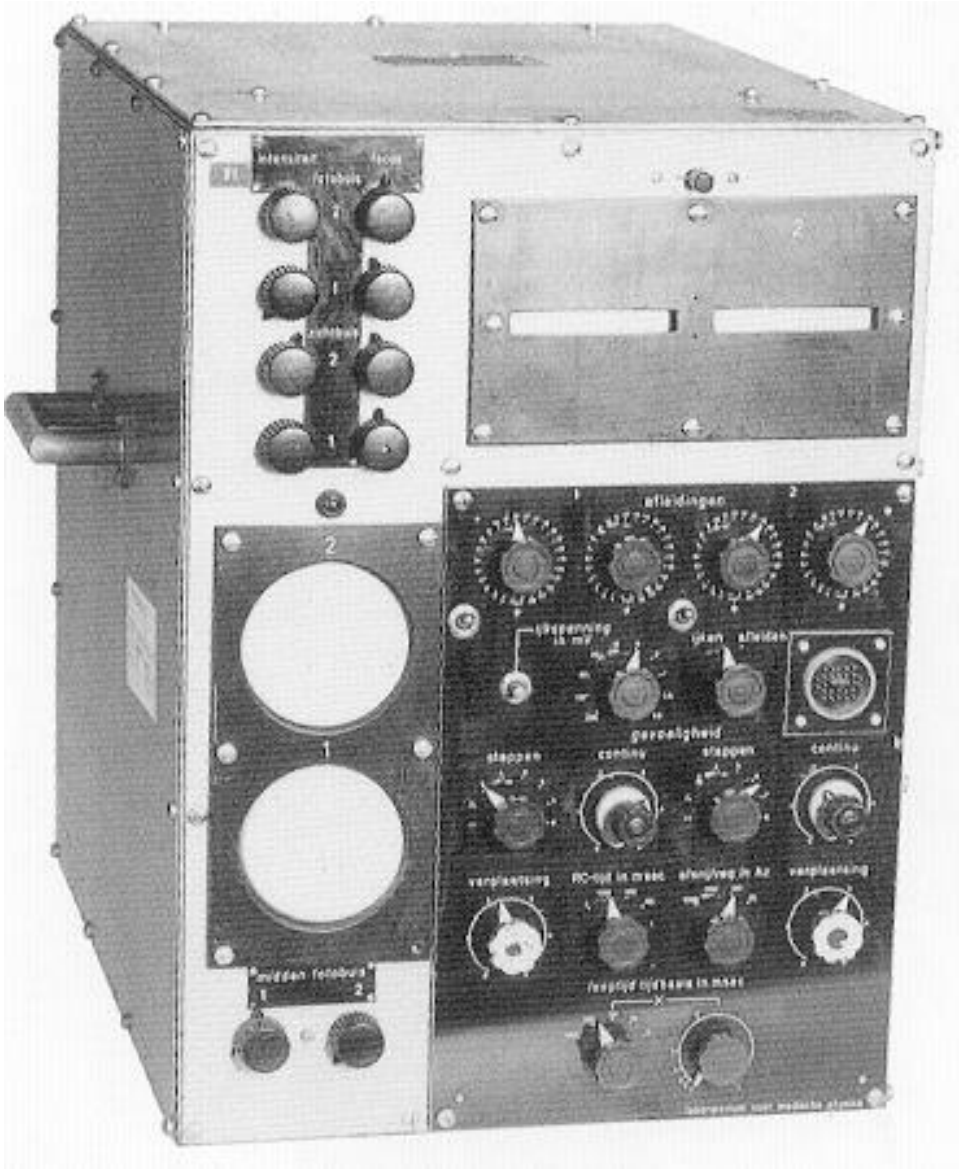
ECG-recording with string galvanometer (W. EINTHOVEN 1903, Nobel Prize 1924)

(L = arc lamp, O = condenser, M-S = magnet with optical lense, T = rotating wheel, C – moving, light-sensitive glas plate)

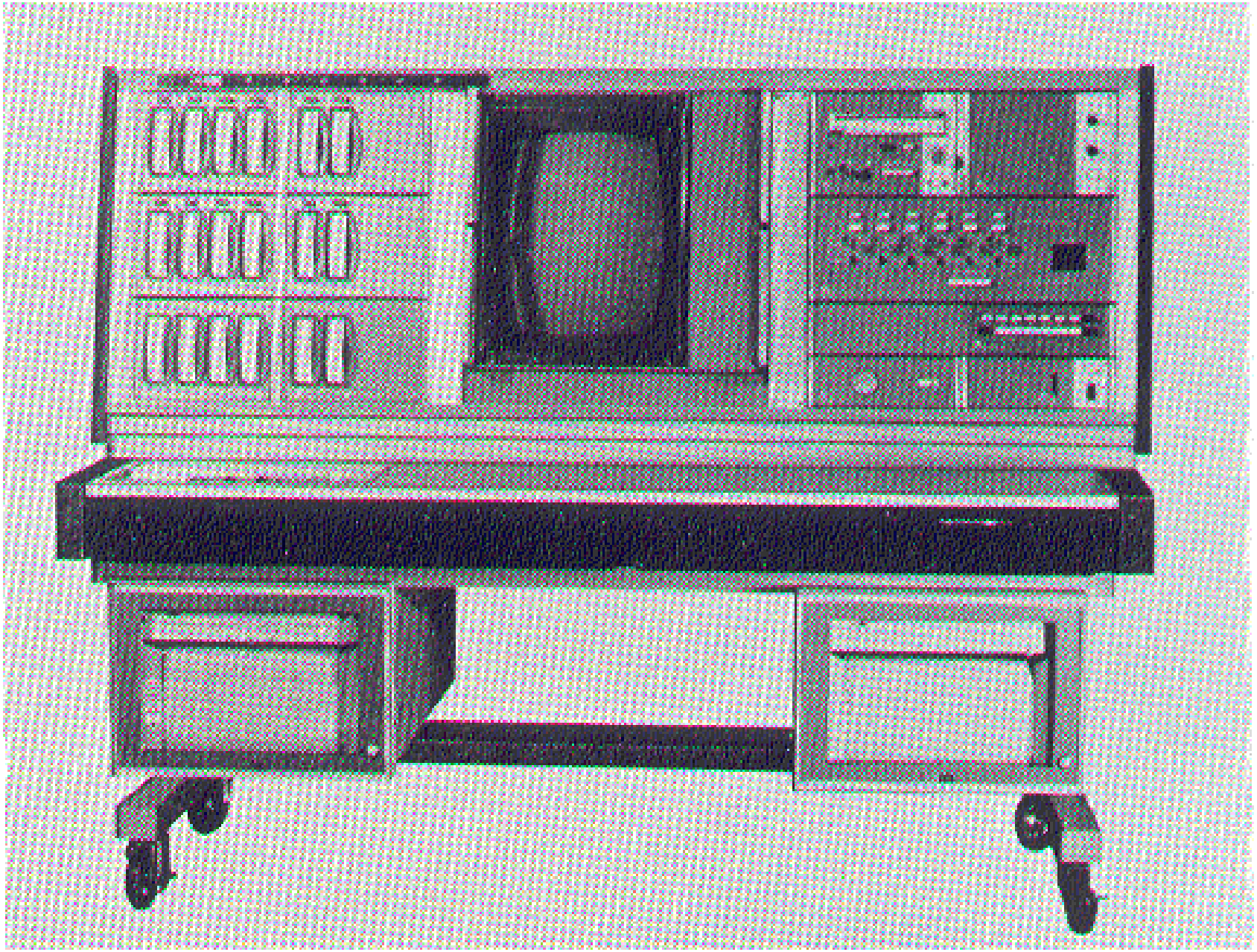


Recorder for electrocardiograms and phonocardiograms in modular configuration

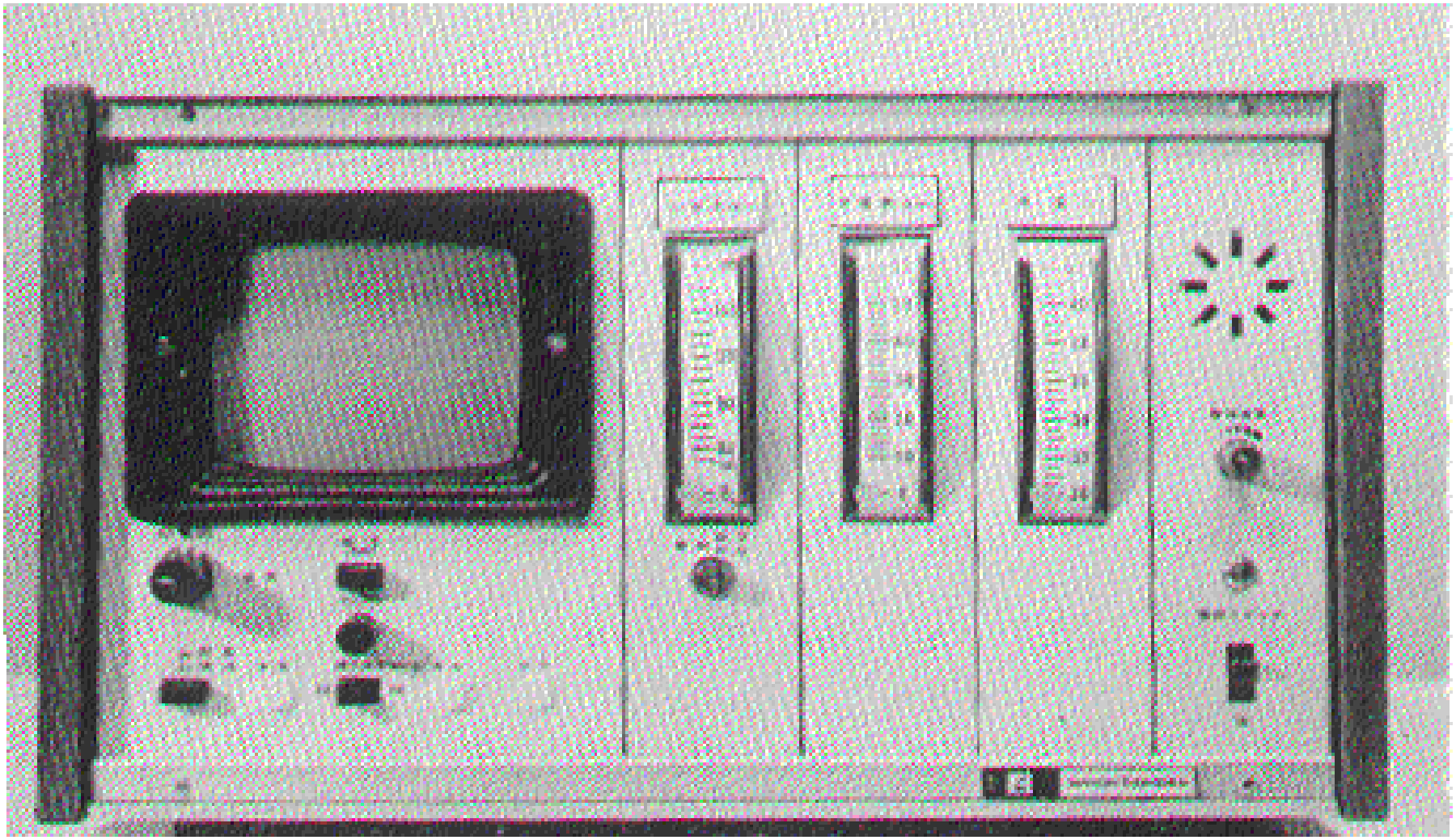
(Siemens, 1940)



2-channel ECG Recorder 1948

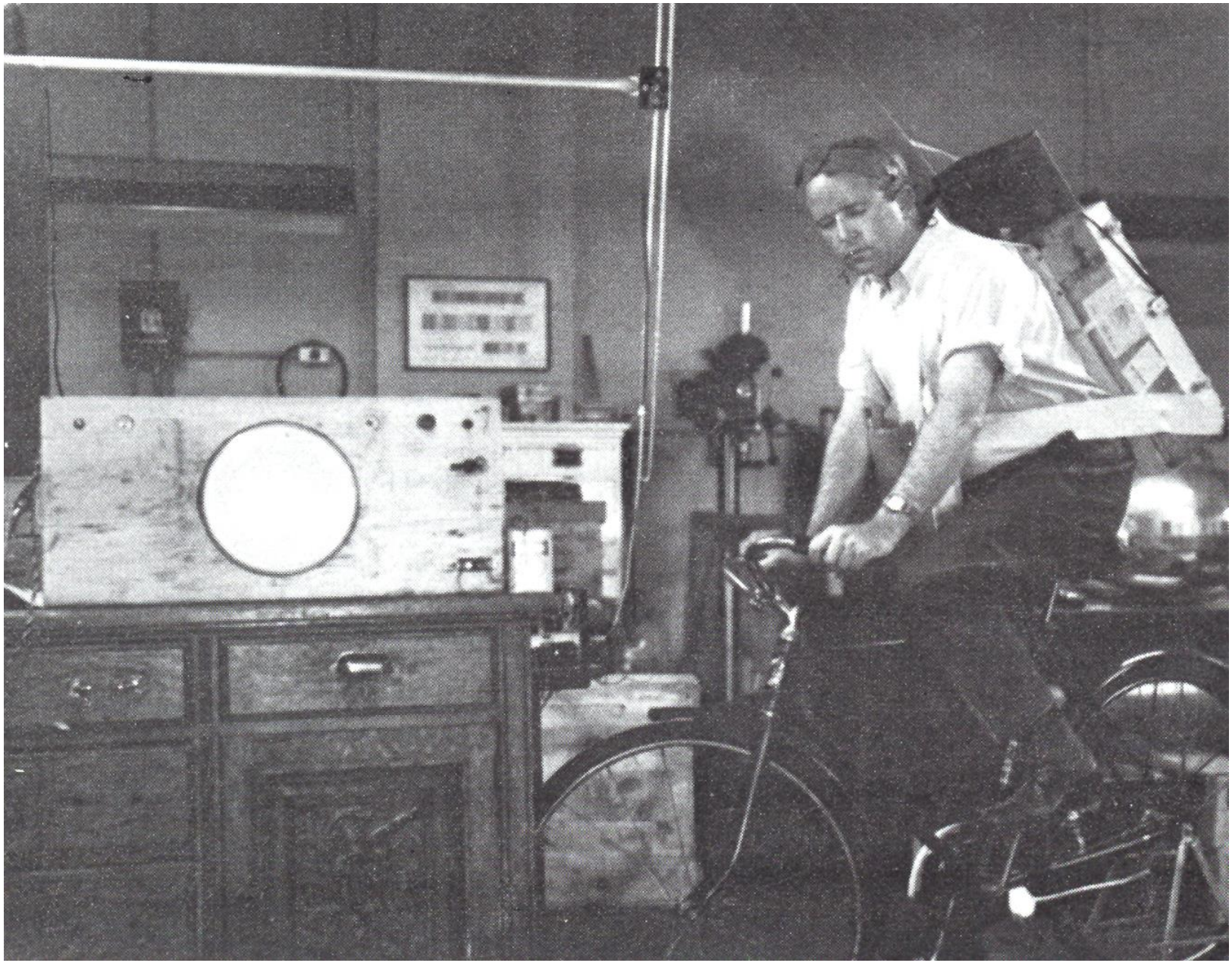


Intensive care – patient monitoring for 6 patients (1973)



Bedside monitor (1973)

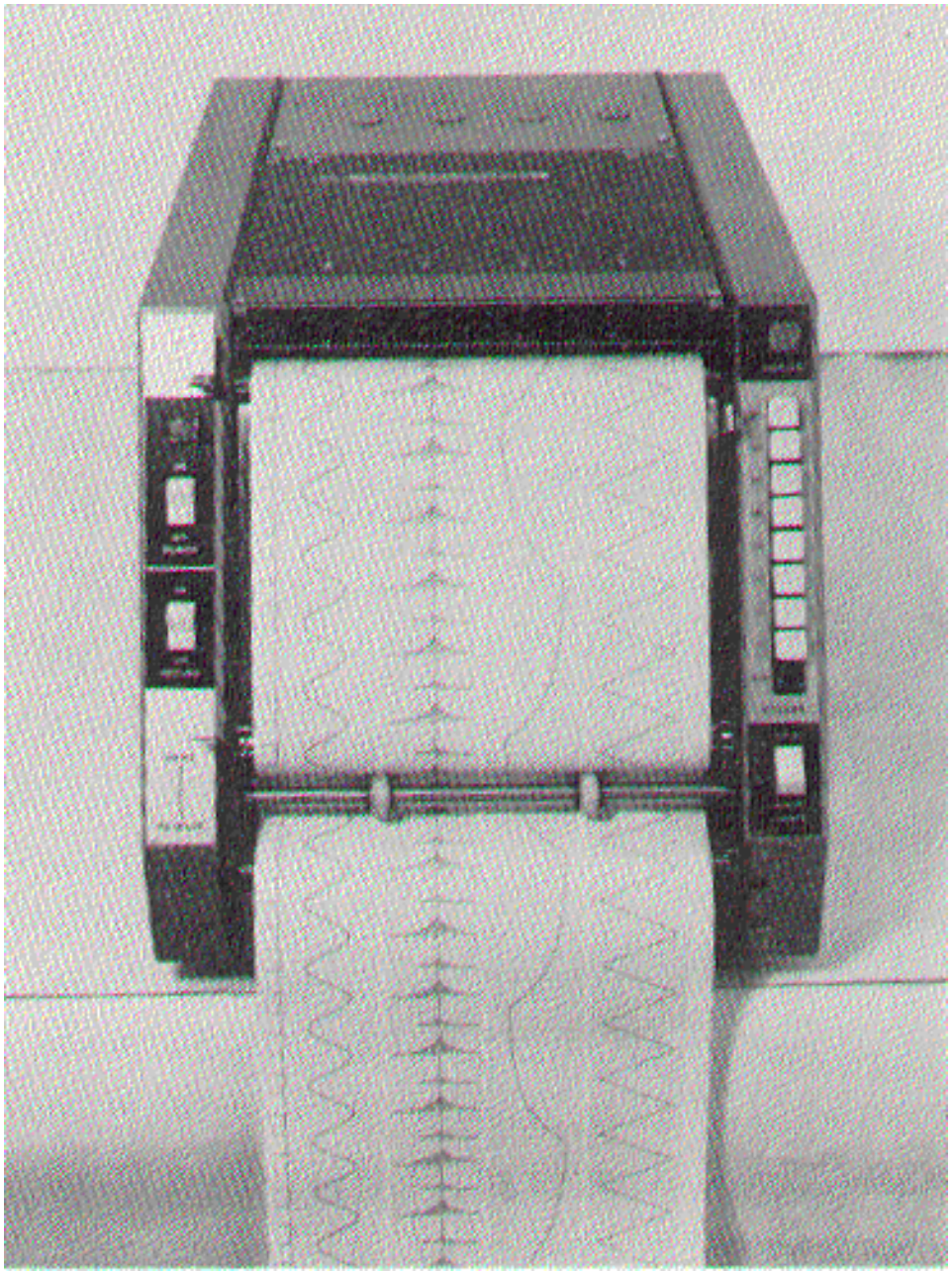
Modern portable ECG-monitor



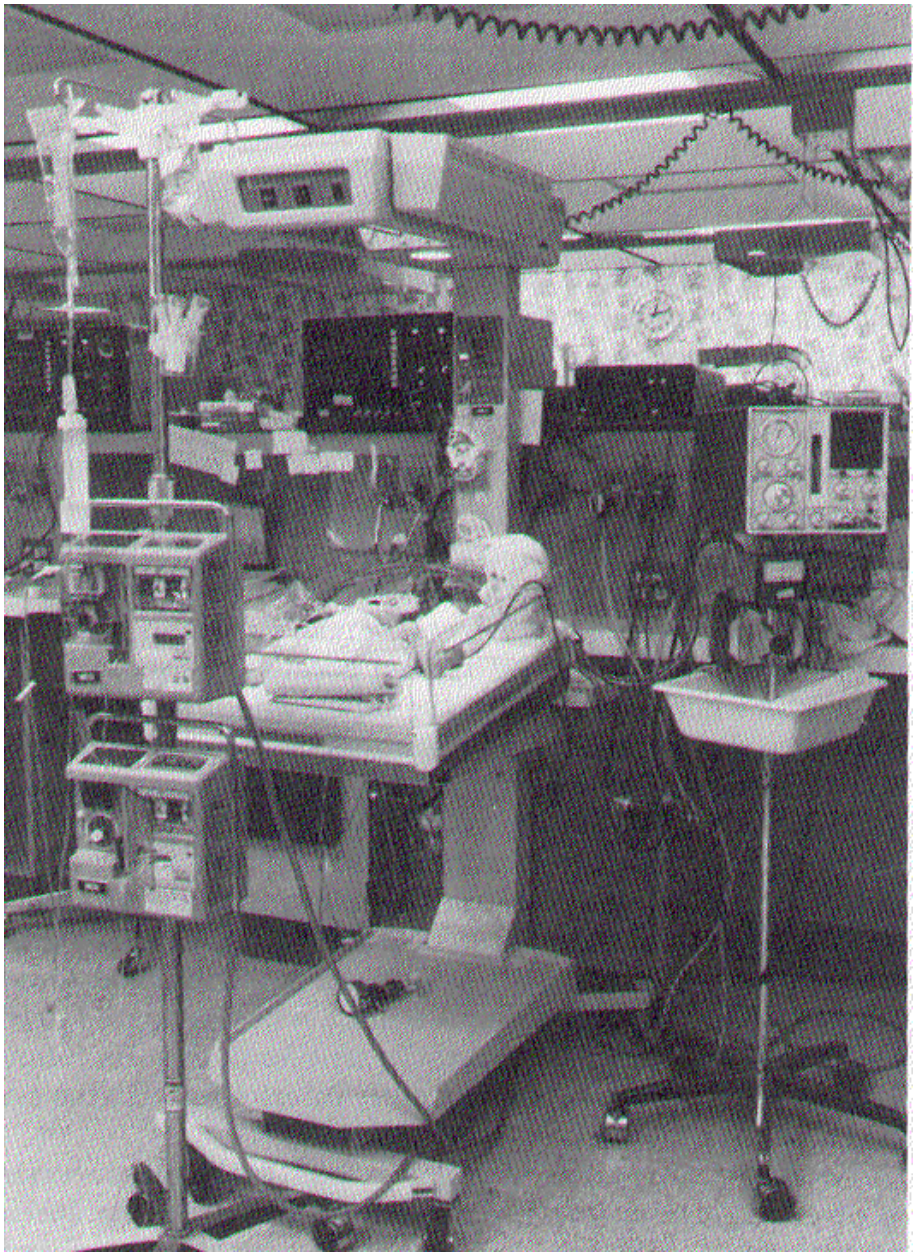
Portable Holter-recorder with 80 lbs (1947, with N.J. Holter himself?), using audiotapes and FM-modulated sub-carrier for analogue recording

12-lead Holter Recorder (42 grams, 68 mm x 53 mm x 16 mm), sampling rate up to 1024 samples per second, recording time: up to 48 hours

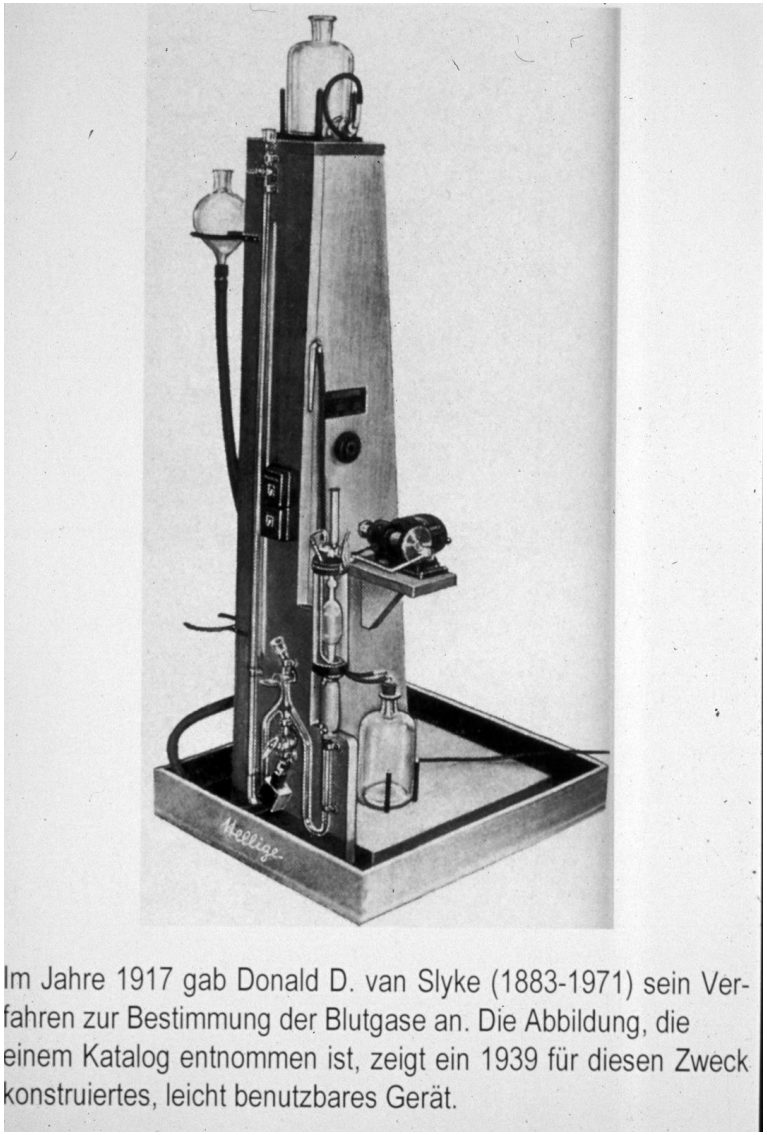
Bicycle ergometer (Hellige, 1994)



Ink-writing 4-channel recorder (Siemens, 1973)

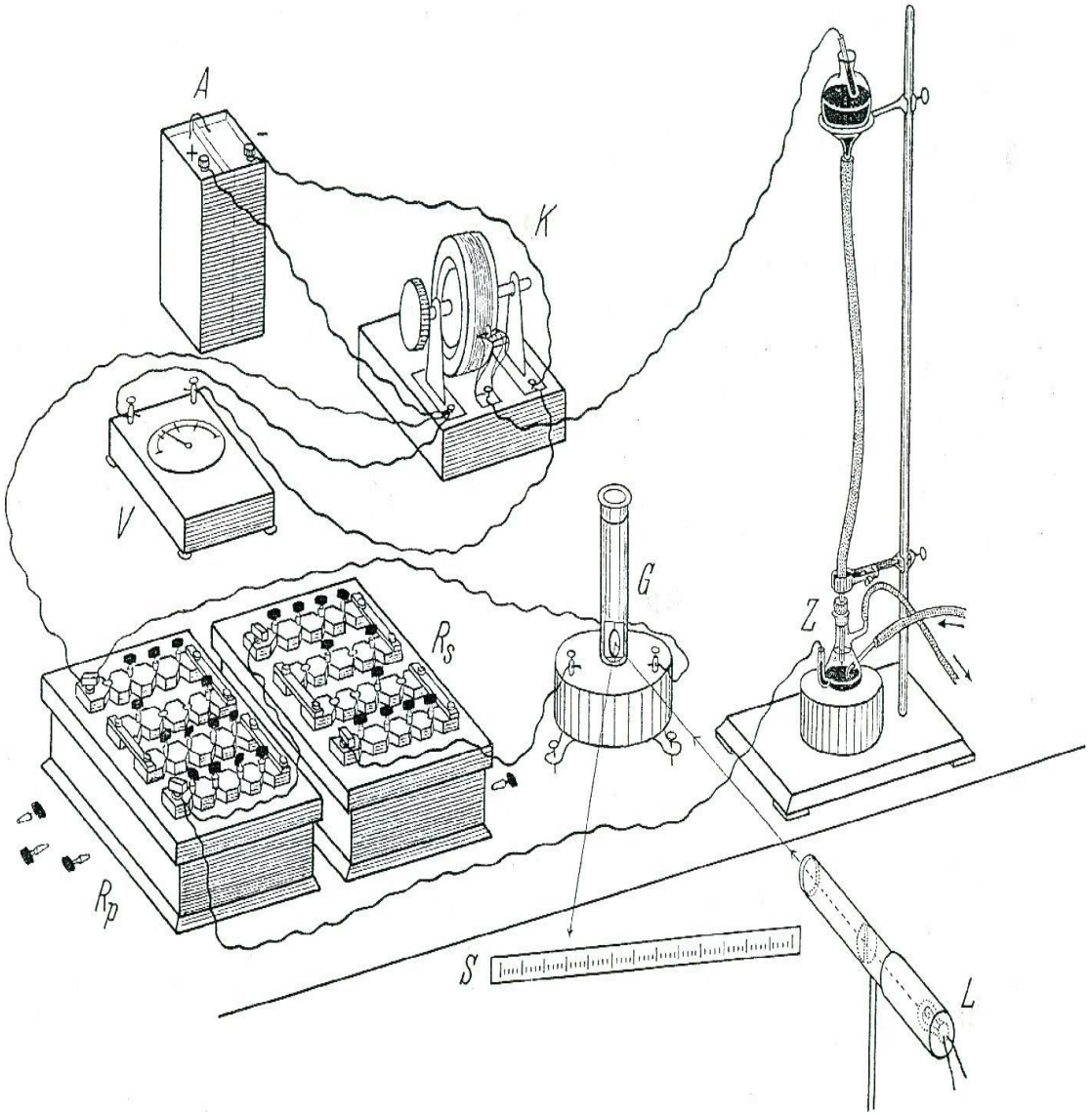


Neonatal intensive care monitoring (1988)

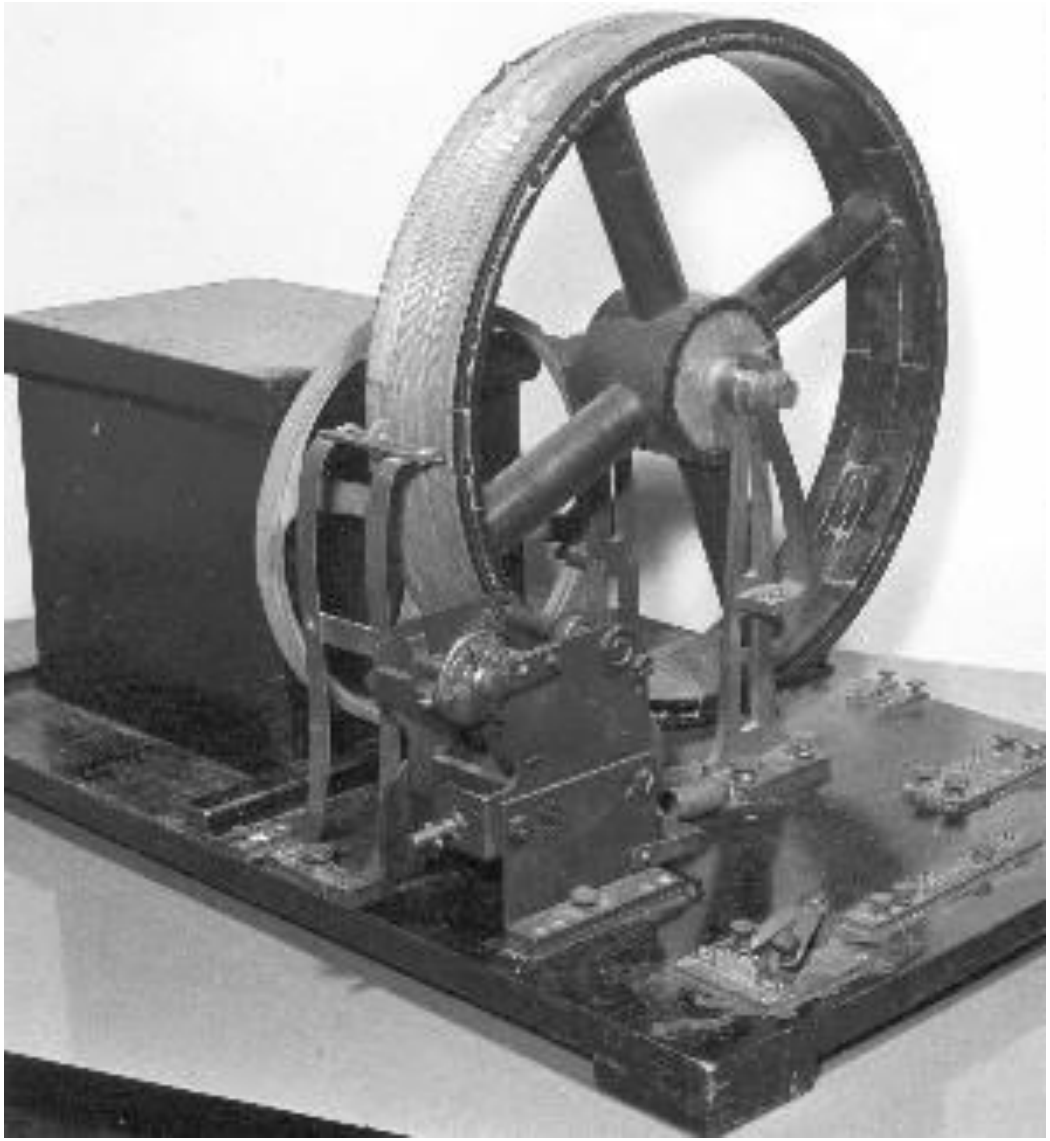


Im Jahre 1917 gab Donald D. van Slyke (1883-1971) sein Verfahren zur Bestimmung der Blutgase an. Die Abbildung, die einem Katalog entnommen ist, zeigt ein 1939 für diesen Zweck konstruiertes, leicht benutzbares Gerät.

Blood gas measurement (D.D. van Slyke, 1917). The shown device was built 1939. The measurement procedure (gas elimination and chemical binding) was employed until the 1960s.



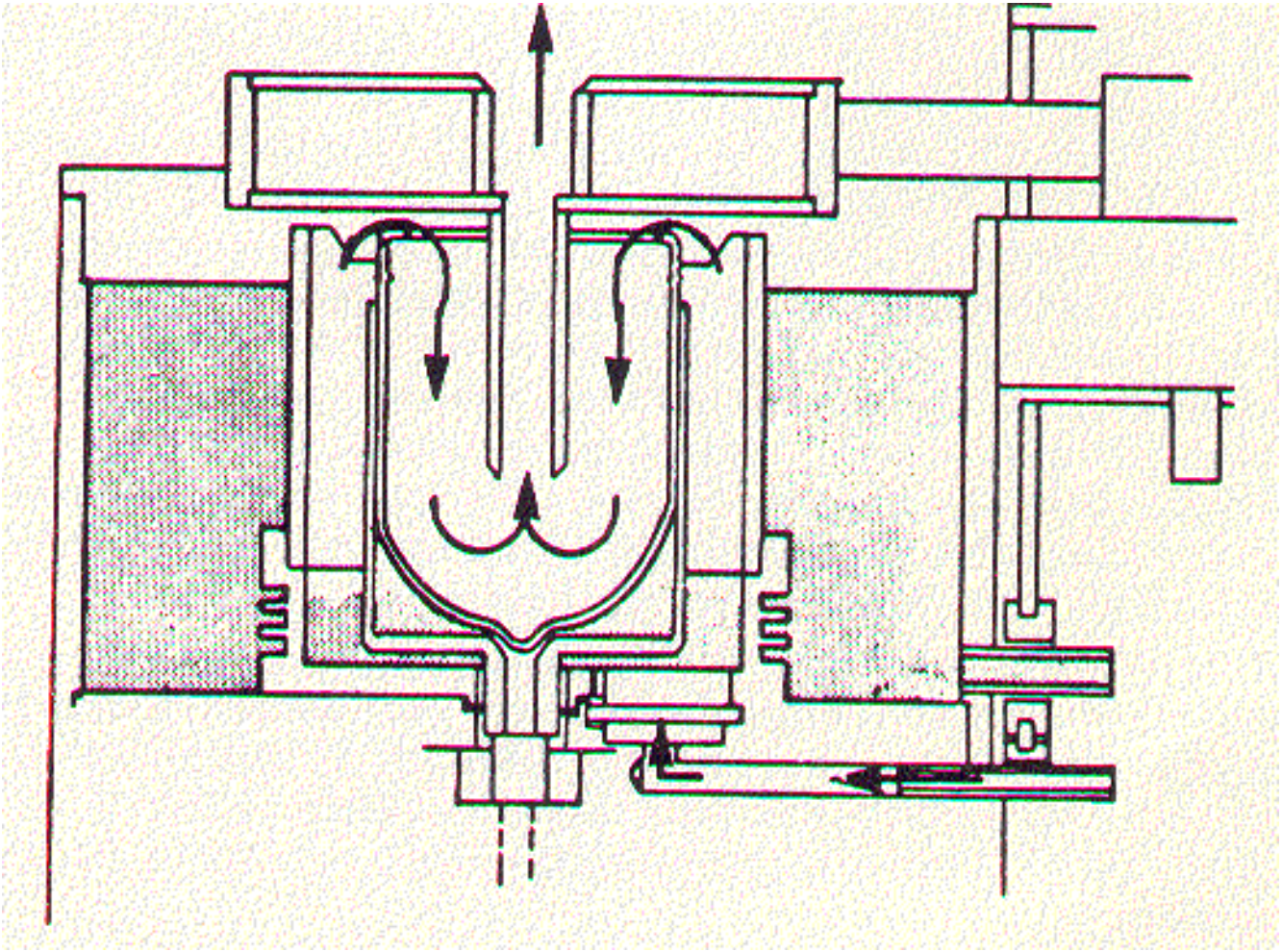
Polarography with the dropping mercury electrode by J. Heyrovsky (Nobel Prize 1959): Principle and measurement schematics



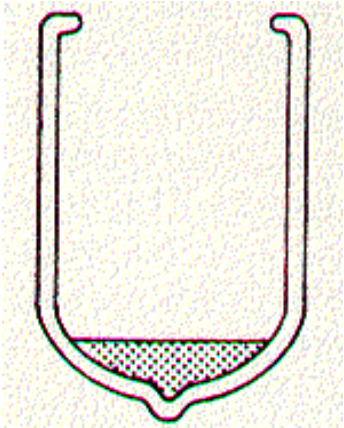
Polarography with the dropping mercury electrode by J. Heyrovsky

(Nobel Prize 1959): First polarograph

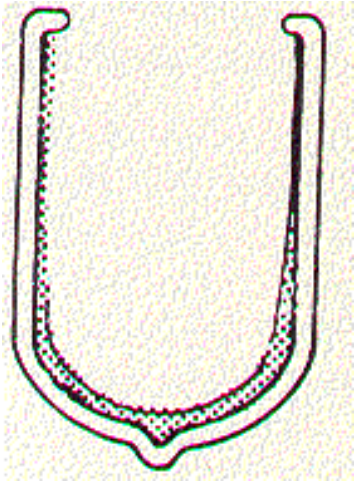
The first appliance for the measurement of the pH-value in blood (Radiometer, 1952)



a. Schematics showing the construction with the rotating container and the gas flow



b. Blood-filled container in in rest and in rotation for the enlargement of the surface in order to accelerate gas exchange

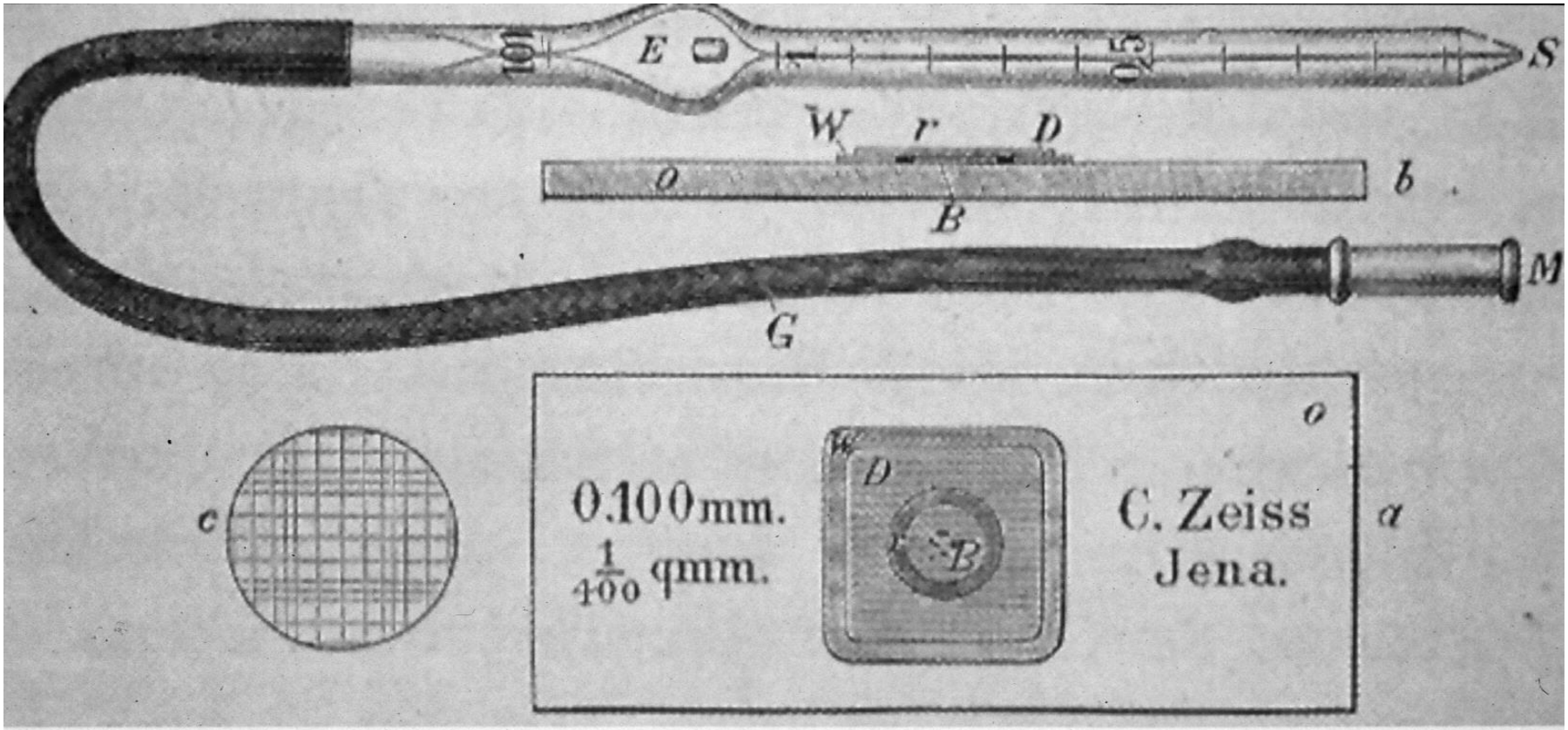


Bloodgas measurement by tonometry, filling volume 0.5 – 10 ml blood, temperature set by water bath (1977)

First industrially designed and fully automatized blood gas analyzer for microvolumes 25 – 40 µl (AVL 1990)

Automated benchtop blood gas analyzer

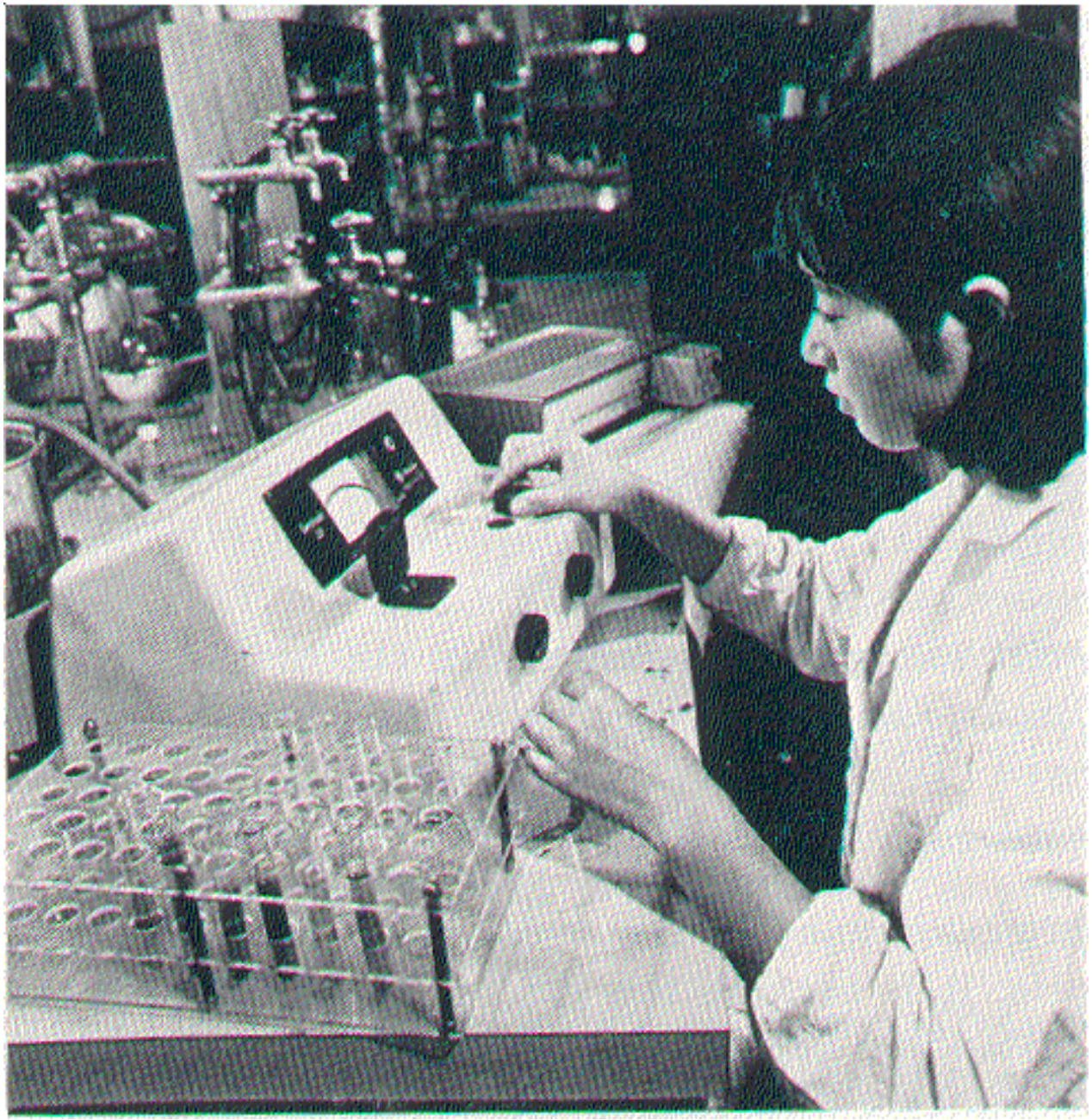
Automatized blood gas analyzer for patient-near measurement



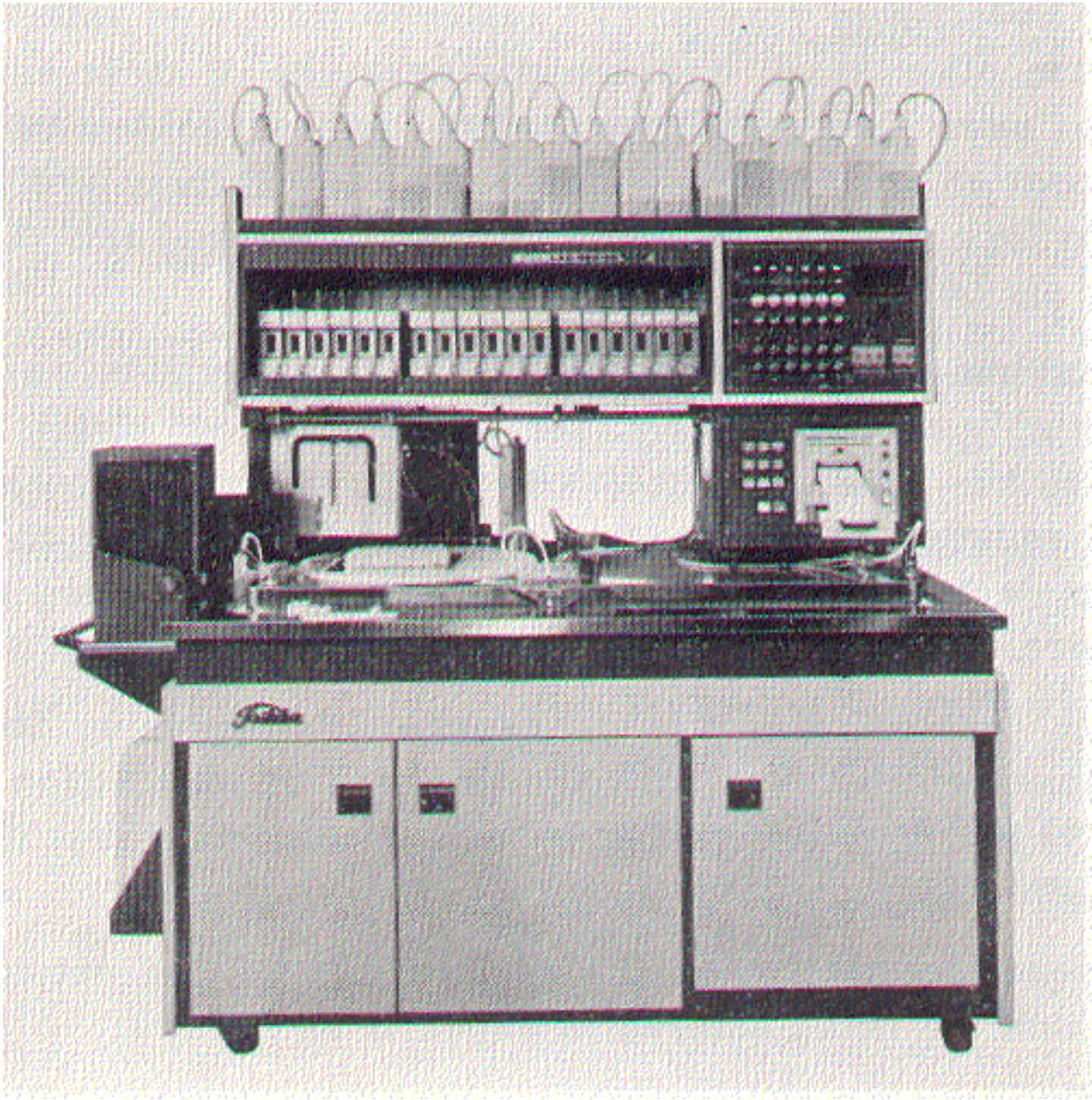
Zählkammer nach Thoma zur Bestimmung der Zahl der Blutkörperchen unter dem Mikroskop mit Mischpipette zur Verdünnung des Blutes. Nach Einführung automatisch arbeitender Zählgeräte in den sechziger Jahren des 20. Jahrhunderts wurde dieses 1878 von dem Pathologen Richard Thoma (1847-1923) eingeführte Verfahren mehr und mehr verlassen.

Blood cell counting using the Thoma-plate and a microscope. Invented and introduced 1878 by R. Thoma and used until the 1960s. Required time about 10 minutes.

Automated blood cell counter (W.H. Coulter, 1947), based on impedance measurement



Electric photometer for in-vitro diagnostic testing (1973)



Equipment for in-vitro diagnostic testing (1973)

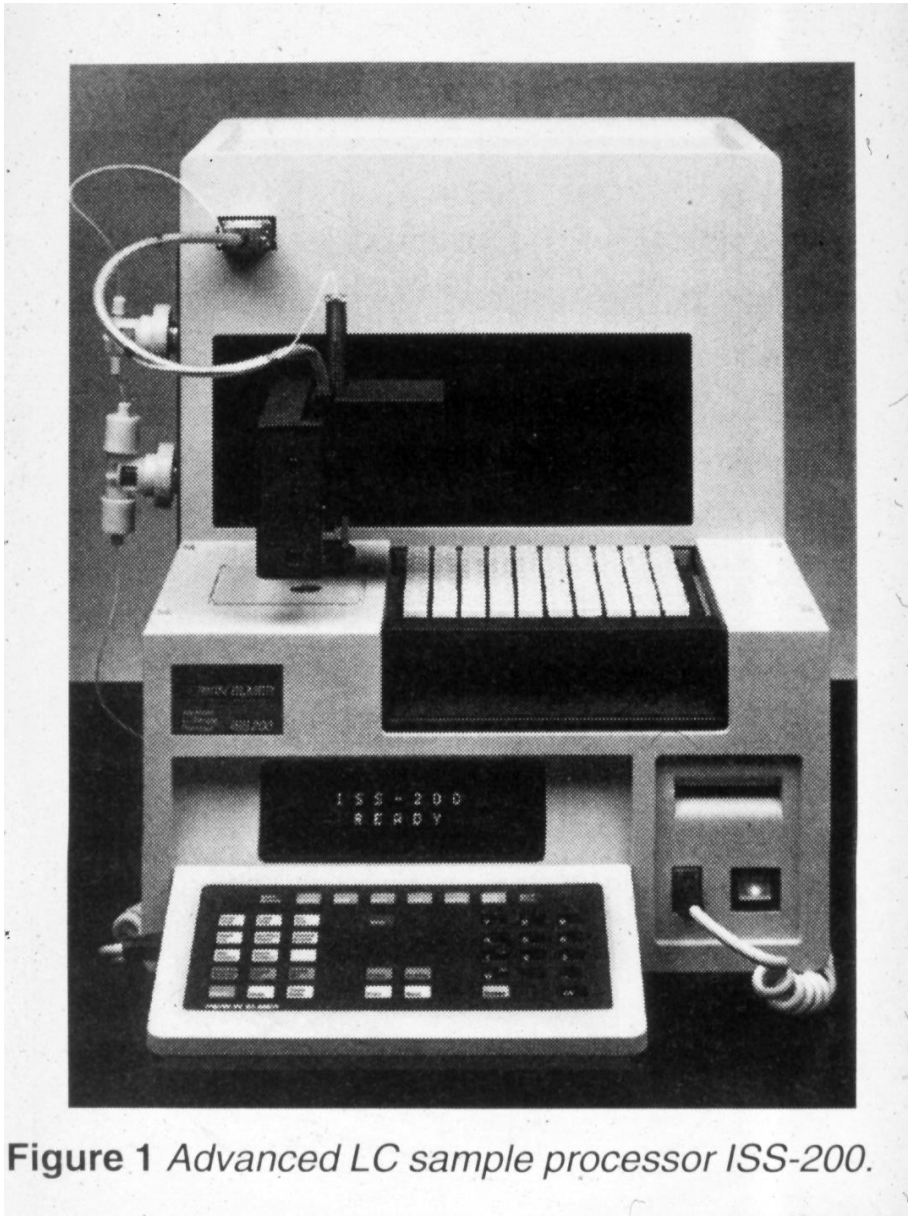
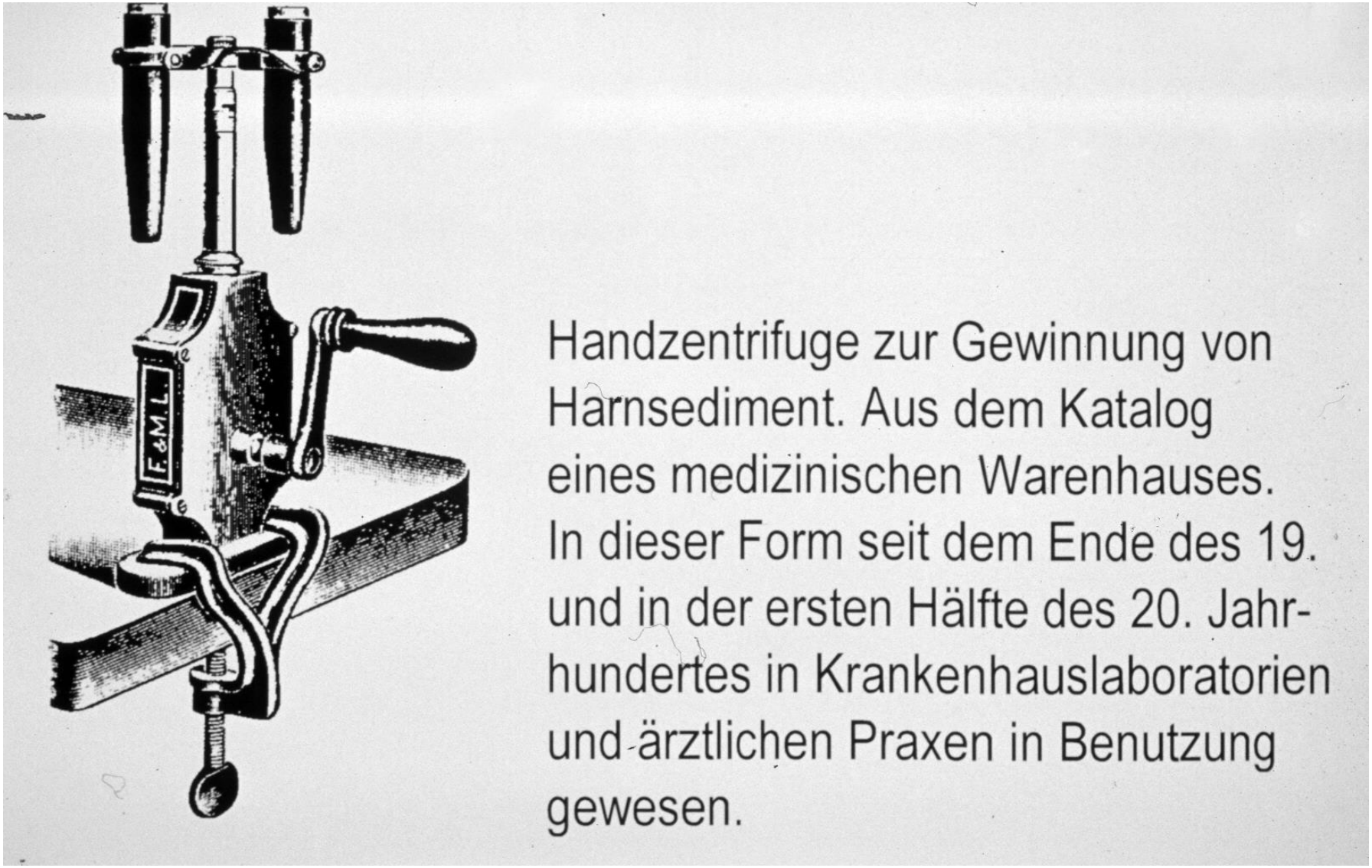


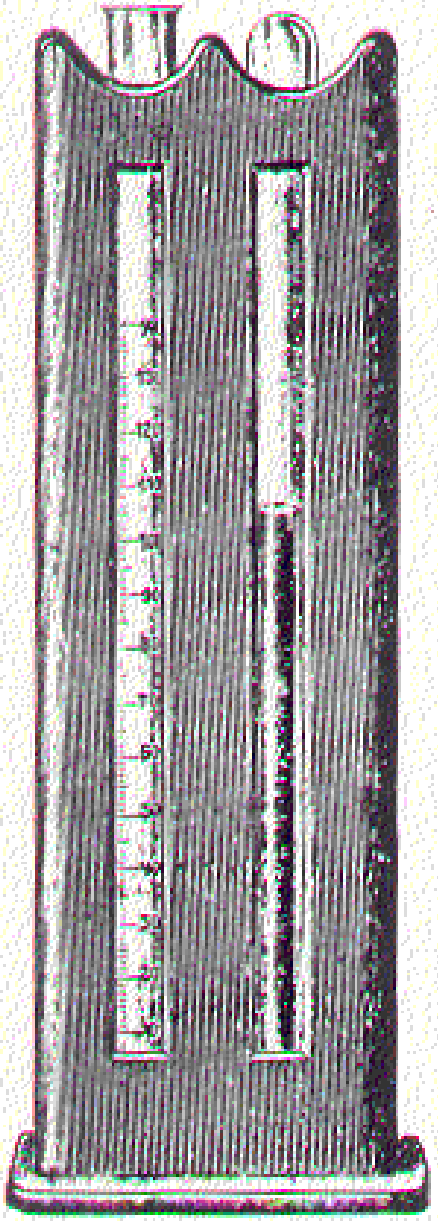
Figure 1 *Advanced LC sample processor ISS-200.*

Liquid Chromatography device with robotic sample handling and automatized measurement (about 1980)

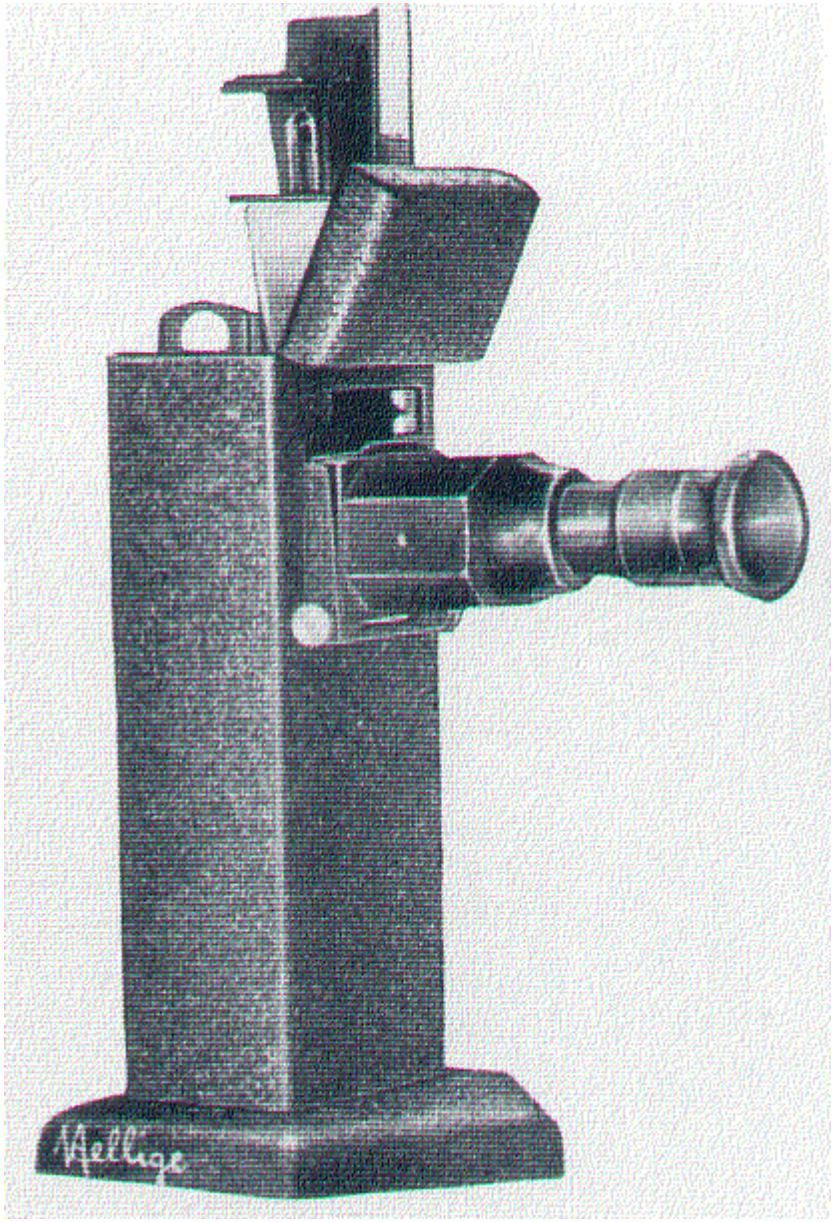


Manually operated centrifuge for two containers and samples, introduced 1890s and used until 1940s

High-performance centrifuge (100 000 g, 30 000 rotations/minute)

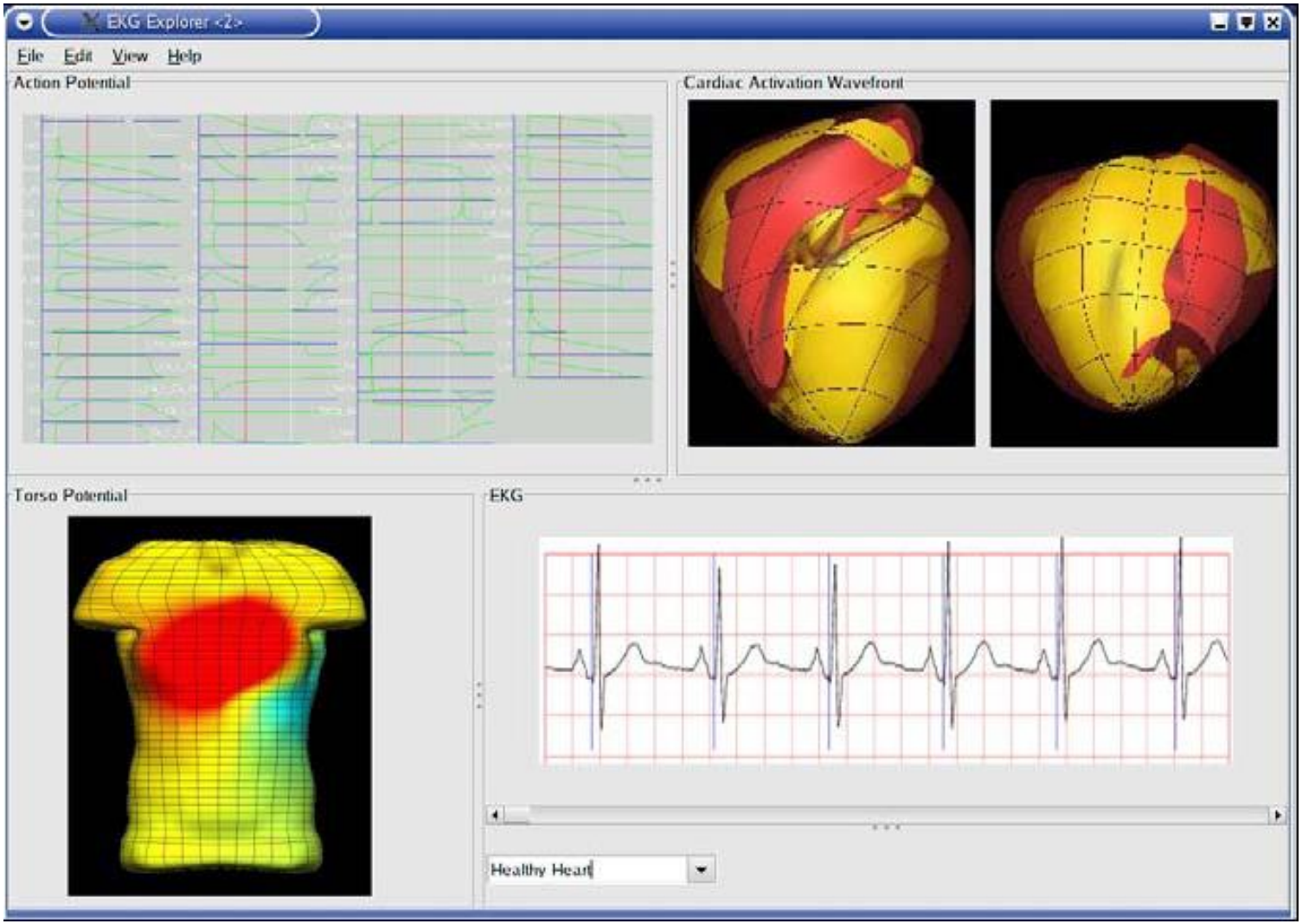


a. Sahli (1905)



b. Autenrieth (about 1925)

Measurement of hemoglobin concentration, based on colour assessment



The Physiome Model

Example of physiome models being used in an educational application. Models of cardiac ion channels together with tissue conductivity yield myocardial activation sequence (upper right). Current flow from the heart to the torso (bottom left) is used to compute the ECG traces (bottom right). Work of Dr Carey Stevens of the Auckland Bioengineering Institut