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Gunnar Jungner and the Principles and Practice of Screening for Disease

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Abstract: We present a biography of Gunnar Jungner, one of the authors of the Principles and Practice of Screening for Disease by JMG Wilson and G Jungner, published by the WHO in 1968. This publication contains ten criteria, which are still consulted, when a new disorder is evaluated for inclusion in a screening program. Gunnar Jungner was a Swedish MD, PhD, specialized in Clinical Chemistry, born in Sweden in 1914. In 1961 he built an automated instrument for the analysis of different components in plasma, with the aim to detect diseases in presumably healthy individuals, to enable start of treatment at an early disease stage. This first automated instrument for Clinical Chemistry in Sweden was used in a screening project, where 90 000 seemingly healthy individuals were included. The study was discussed extensively and he was invited to present the results at different international meetings, where he also met JMG Wilson. Gunnar Jungner developed the instrument further together with his brother Ingmar and the Swedish gas company AGA. The brothers also established an out-patient ward in Stockholm, where people could come for health screening.

Keywords: screening; pre-symptomatic; Jungner; biography

As part of the welcome session of the meeting of the International Society for Neonatal Screening (ISNS) in The Hague, 11–14 September 2016, we presented information about the lives and work of Drs Maxwell Wilson and Gunnar Jungner. This was initiated by Drs Kate Hall and Peter Schielen, members of the council of the International Society for Neonatal Screening. Peter Schielen gave a background and Philip Wilson and Lars Jungner, sons of Maxwell Wilson and Gunnar Jungner, presented the life and work of their fathers. Peter Schielen ended the session with a summary of the development since the publication of the Principles and Practice of Screening for Disease. Since there are no comprehensive biographies published earlier, concerning the seminal work by Maxwell Wilson and Gunnar Jungner, we now publish the biography of Gunnar Jungner for the first time. The information has been gathered by several interviews with Ingmar and Lars Jungner, brother and son of Gunnar Jungner. We have also received publications from Ingmar Jungner and retrieved references from the library at Karolinska Institutet. All photographs and pictures of documents are from the family archives of Ingmar and Lars Jungner.

Olof Gunnar Hugo Jungner was born in 1914 in the vicarage of Vilske-Kleva, a village in the southwestern part of Sweden, where his maternal grandfather was the vicar. His father Hugo Jungner was a PhD of history and worked as a headmaster/teacher. He became well known for his interpretation of one

of the most famous Swedish run-stones— "Sparlösastenen"—from around the year 800. Gunnar Jungner grew up mainly in Stockholm and had two siblings, his older sister Runa and his ten-year younger brother Ingmar. He attended secondary school at Kungsholms läroverk in Stockholm with science as the main subjects and he had top grades in mathematics, chemistry and physics when he graduated from school in 1933.

Figure 1. Gunnar Jungner, at 24 years of age. Photograph taken at the engagement to Greta Nelson in 1938.

He was a top student and, apart from Karolinska Institutet, he was invited to study at the Royal Institute of Technology. He studied medicine at Karolinska Institutet in Stockholm and, in parallel, he worked on his PhD thesis at the Department of Medical Chemistry at Karolinska Institutet (Figure 1).

He married Greta Nelson in 1940 (Figure 2) and they had two children: the late Gudrun, born in 1942 and Lars, born in 1944, living in Stockholm. This was while he was finishing his education. He became an MD in 1943 and defended his PhD thesis in 1945 [1].

Figure 2. Gunnar Jungner and his wife Greta (born Nelson).

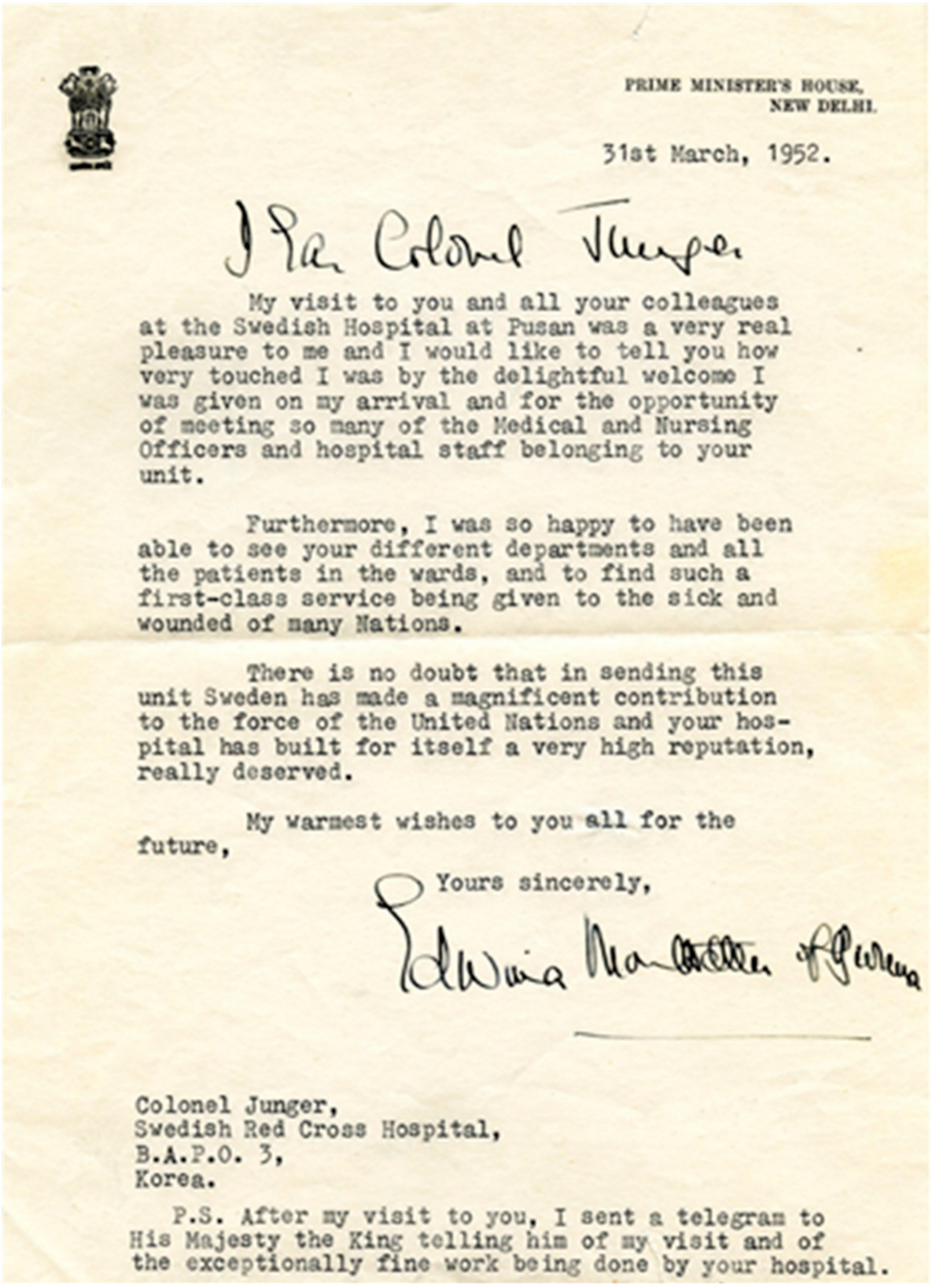
He was appointed associate professor at the Department of Medical Chemistry at Karolinska Institutet the same year.

During the years 1946–1954, Gunnar Jungner was the head of the Clinical Chemistry Laboratory of the Central Hospital of Umeå and, in parallel, he worked as a physician for the military at two of the Northern Regiments (1950–1954).

His military commitment also led to a year as Commanding Officer at the Swedish Red Cross Field Hospital in Pusan, Korea in 1952, during the Korean War. His work there was very much appreciated as exemplified by the documents below (Figures 3 and 4):

In 1954 he was appointed associate professor and head of the Department of Clinical Chemistry at Sahlgrenska Hospital at the University of Gothenburg. He combined this position with clinical work at the Central Laboratory of the Sahlgrenska Hospital. Ten years later he was stricken with several heart attacks, which forced him to resign in 1968. He moved back to Stockholm and worked as a Senior Medical Officer at the Planning Division of the Medical Board of the Swedish Armed Forces 1968–1972. He died, aged 68 years, in 1982 due to heart failure.

During 1959–1960, Gunnar Jungner spent a year as Visiting Scientist at the National Institute of Health (NIH), with George Z. Williams, who was head at the Department of Clinical Pathology, in Bethesda, Maryland, USA (Figure 5). There, he performed research with the aim to automate clinical laboratory analyses. The work was carried out in association with the aircraft manufacturer Boeing, whom NIH had commissioned to construct an automated blood analyser. This was a turning point in Gunnar Jungner´s professional life. Already at this stage he had the idea that such an instrument could be used for what he called "chemical health screening". The aim was to find diseases in seemingly healthy people to be able to modify the disease progression at an early stage. He was offered a position as a professor at NIH but decided to go home to Sweden to realize his ideas.



PRIME MINISTER'S HOUSE,
NEW DELHI.

31st March, 1952.

My dear Colonel Junger,

My visit to you and all your colleagues at the Swedish Hospital at Pusan was a very real pleasure to me and I would like to tell you how very touched I was by the delightful welcome I was given on my arrival and for the opportunity of meeting so many of the Medical and Nursing Officers and hospital staff belonging to your unit.

Furthermore, I was so happy to have been able to see your different departments and all the patients in the wards, and to find such a first-class service being given to the sick and wounded of many Nations.

There is no doubt that in sending this unit Sweden has made a magnificent contribution to the force of the United Nations and your hospital has built for itself a very high reputation, really deserved.

My warmest wishes to you all for the future,

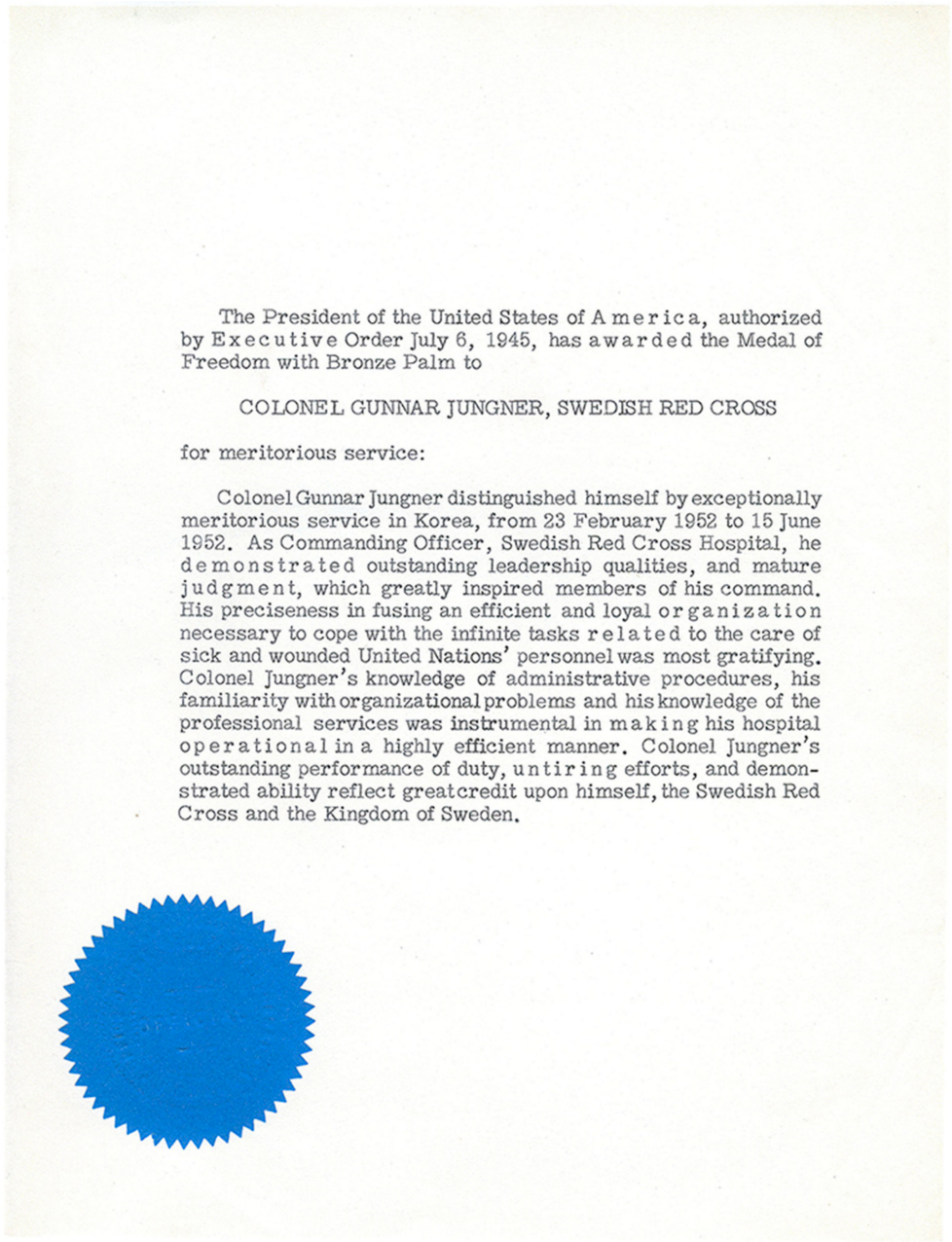
Yours sincerely,

Edwina Mountbatten of Burma

Colonel Junger,
Swedish Red Cross Hospital,
B.A.P.O. 3,
Korea.

P.S. After my visit to you, I sent a telegram to His Majesty the King telling him of my visit and of the exceptionally fine work being done by your hospital.

Figure 3. Letter from Edwina Mountbatten, former Vicereine and Governor of India, 31 March 1952.



The President of the United States of America, authorized by Executive Order July 6, 1945, has awarded the Medal of Freedom with Bronze Palm to

COLONEL GUNNAR JUNGNER, SWEDISH RED CROSS

for meritorious service:

Colonel Gunnar Jungner distinguished himself by exceptionally meritorious service in Korea, from 23 February 1952 to 15 June 1952. As Commanding Officer, Swedish Red Cross Hospital, he demonstrated outstanding leadership qualities, and mature judgment, which greatly inspired members of his command. His preciseness in fusing an efficient and loyal organization necessary to cope with the infinite tasks related to the care of sick and wounded United Nations' personnel was most gratifying. Colonel Jungner's knowledge of administrative procedures, his familiarity with organizational problems and his knowledge of the professional services was instrumental in making his hospital operational in a highly efficient manner. Colonel Jungner's outstanding performance of duty, untiring efforts, and demonstrated ability reflect great credit upon himself, the Swedish Red Cross and the Kingdom of Sweden.

Figure 4. Announcement 6 July 1945, that Colonel Gunnar Jungner, Swedish Red Cross, has been awarded the Medal of Freedom with Bronze Palm by the President of the United States of America for meritorious service.

Figure 5. Meeting at the NIH in Bethesda in 1960. The second man from the left is George Z. Williams and the fifth man from the left Gunnar Jungner.

Gunnar Jungner returned to Sweden in October 1960 and started to build a prototype of an automated instrument for biochemical analysis of serum samples. The purpose was to simultaneously determine the concentration of several biochemical parameters. The aim was, originally, to help general practitioners diagnose diseases at an early stage before symptoms had occurred, to be able to modify the disease progression. He built the instrument much with his own hands (Figure 6) and with the help of his ten-year younger brother, Ingmar Jungner, MD, associate professor at Karolinska Institutet, plus two instrument engineers and volunteering medical students (Figure 7). The brothers started a clinical chemistry laboratory, the Central Automation Laboratory, CALAB, which grew to large dimensions and served outpatient wards, as well as some hospitals, until 1996.

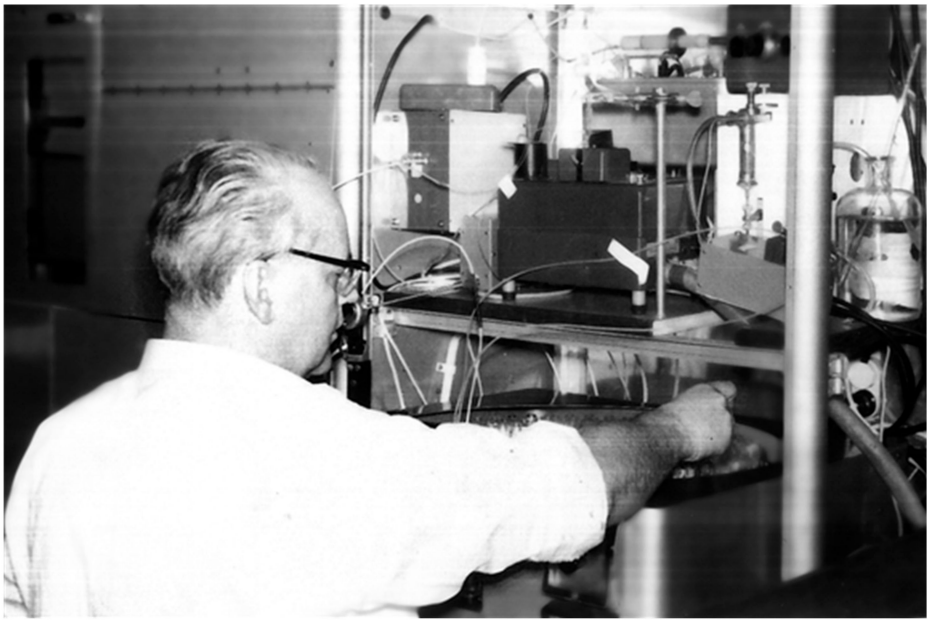


Figure 6. Gunnar Jungner working with a unit in Stockholm in 1960.

Figure 7. The Jungner brothers in front of the Värmland equipment in 1962.

The instrument (in use from 1962 to 1965) could analyse: haemoglobin, hematocrit, serum iron, creatinine, transaminases, thymol turbidity, zinc sulphate, betalipoprotein, cholesterol, protein bound hexoses, and sialic acid. The capacity was 480 serum analyses per hour, or approximately 5000 analyses per day. It was connected to a unit for registration of patients and a printer for results. This was the first "multianalyser" for clinical chemistry in Sweden [2,3].

When the instrument was reported to the National Board of Health (a state institution giving advice to the government), the Swedish Government decided to launch a mass health screening trial led by Gunnar Jungner—"the Värmland survey" and under the supervision of the National Board of Health. Some of the advantages foreseen by Gunnar Jungner and the group were the following: Changes in blood usually appear before clinical symptoms arise. Many clinical symptoms can be explained by metabolic disturbances, which can be identified in the blood. Blood serum is easy to take, can be stored for a long time, and transported long distances for analysis. It can be analysed on a large scale and a high number of parameters can be analysed in each sample, which will increase the medical value [4–7].

Included in the Värmland study were 90,000 persons over 25 years of age. The Värmland study was performed together with the screening by mass miniature photofluorography of the chest to diagnose TBC, which had been going on since the 1940s. A team of paramedics took the history of the individual, measured height, weight and blood pressure and an X-ray of the chest was performed. Urine was tested for albumin and sugar, and serum was sent to the laboratory in Stockholm. All twelve biochemical parameters were analysed by the instrument. Cases with aberrant results of any of the investigations were referred to local doctors.

More than one million analyses were performed within 25 months during 1962–1964. The samples were transported 300 km daily by train from Karlstad in Värmland to the laboratory in Stockholm. A total of 7620 persons were referred for follow up and 6804 diagnoses were recorded in 5539 persons. Among the limitations were missed cases with malignancies and long waiting times for follow up [4–7].

The study had many positive effects and gave guidance how to launch future health interventions. It was discussed extensively in Sweden with respect to the new possibilities for preventive medicine, as well as the ethical issues with missed cases and false positive results, and plans were made for further studies.

Gunnar Jungner was invited to attend several international meetings in the early and mid-60s dealing with pre-symptomatic screening in Europe and the USA and he became a close friend of Dr Morris Collen at the Kaiser Permanente Institute in Oakland, California, who was performing health screening [8,9]. We know that he met Maxwell Wilson at some of these meetings and that they became friends, visiting each other in their homes in England and Sweden. One of these meetings was a colloquium held at Magdalen College in Oxford in 1965. Maxwell Wilson gave a talk: Some principles of Early Diagnosis and Treatment, where he presented, almost word by word, and later published ten requirements for satisfactory case-finding, and Gunnar Jungner talked about the subject of chemical health screening. Presentations were also given by Morris Collen and a few other experts [4–6].

At a meeting arranged by the WHO in Prague in 1964 Gunnar Jungner gave a report of the Värmland project [3]. We do not know if this was the occasion on which he was asked to write the Principles and Practice of Screening for Disease with Maxwell Wilson, but it is a possibility, since the book was published in 1968 [10].

The Swedish international corporation AGA agreed to produce a new version of a clinical chemistry instrument constructed by Gunnar Jungner and his brother Ingmar, named the AutoChemist (Figure 8). The first machine was ready in 1965. This new equipment was exported to countries around the world, one of which was Morris Collen's laboratory at the Kaiser Permanente Institute in California. It was used for pre-symptomatic screening by outpatient wards, as well as for diagnostic purposes in hospitals [11–24].

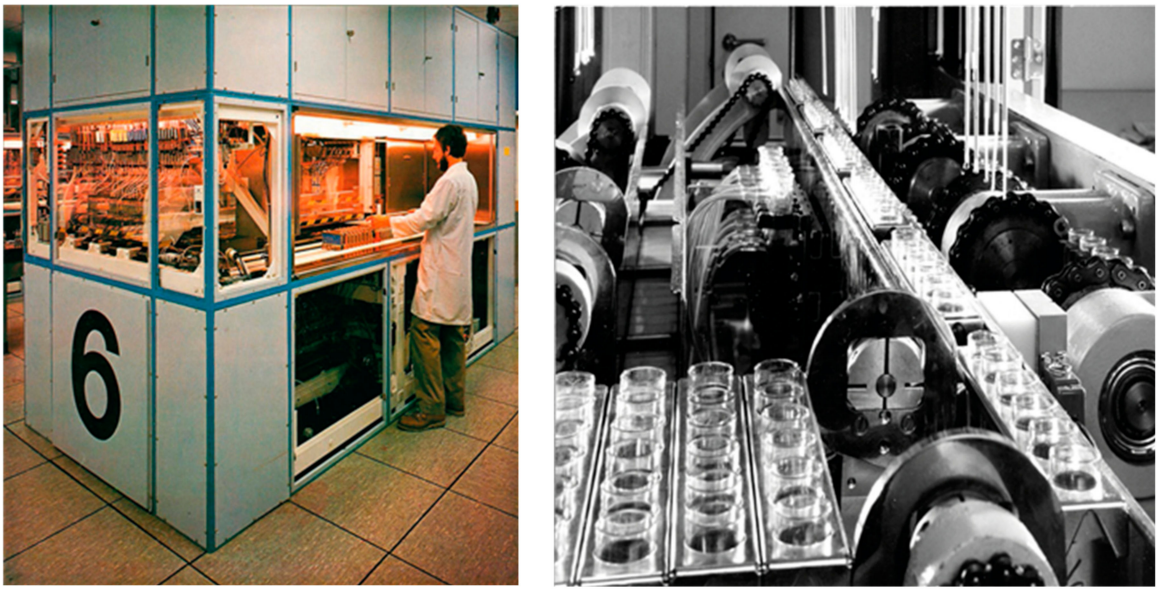


Figure 8. The Autochemist, 1965.

Gunnar and Ingmar Jungner created an outpatient ward where people could come for health controls: the "MultiTest Centre" (Figures 9 and 10). The aim was to diagnose treatable disorders at an early stage. The individual filled in a form with information of inherited disorders, earlier diseases, and other facts of interest. This was followed by clinical investigations of eyes and sight, hearing, blood pressure, and an ECG was performed. Urine was investigated for sugar, protein, and bacteria, and some 40 clinical chemistry parameters were analysed in a plasma sample. Finally, a clinical investigation was performed by a physician. All data was saved in a database.

Figure 9. First page of a flyer for the MultiTest Centre described in the text.

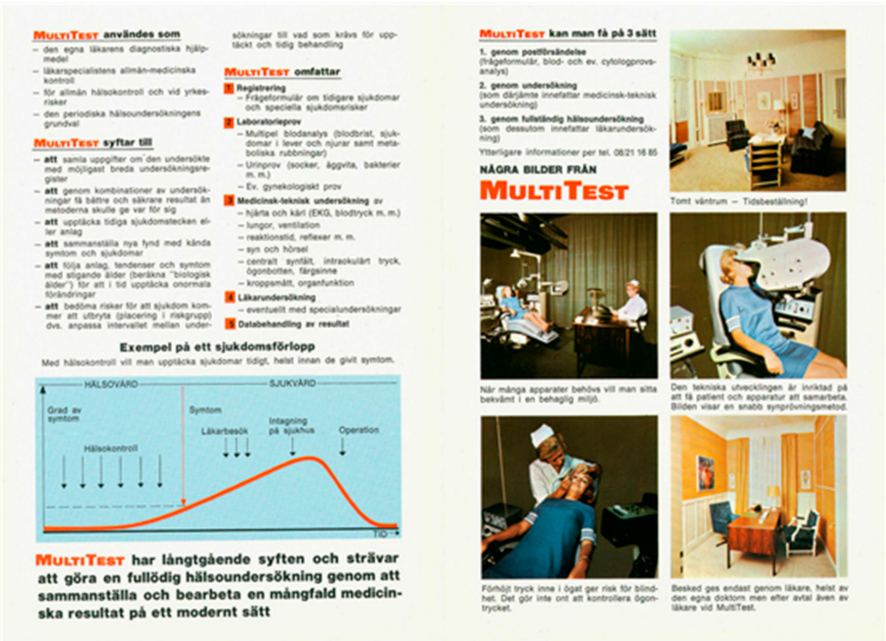


Figure 10. Second page of a flyer for the MultiTest Centre described in the text.

A large database with 36 million test results from individuals with or without diseases was built. This has become an extremely valuable resource for epidemiological research [25]. Ingmar Jungner has donated the database to Karolinska Institutet along with funding for research by the "Foundation of Gunnar and Ingmar Jungner", and it is used today for epidemiological studies [26].

Gunnar Jungner was very dedicated to his work and spent most of his time working (Figure 11). He liked to watch football and he enjoyed music and played the piano.

Figure 11. Gunnar Jungner, 1960, aged 46 years.

Author Contributions: Lars Jungner and Ingmar Jungner have contributed with the main part of the information in this article, Martin Engvall and Ulrika von Döbeln have gathered the information, Ulrika von Döbeln has written the article and all authors have revised the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

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