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Zeiss Ikon's "Statistical Machine"

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Zeiss Ikon pioneered in the automation of the storage and retrieval of business records. In 1931, well before digital computers, Emanuel Goldberg of Zeiss Ikon demonstrated what may have been the first document retrieval system using electronics.

Emanuel Goldberg, another example of academic talent recruited by Zeiss, was born in Moscow in 1881. He went to Germany for graduate study and stayed. By 1917, when he left his professorship in Leipzig to join Zeiss, the versatile Goldberg had contributed significantly to galvanizing, photochemistry, photography, and color printing.

Initially a technical advisor at Jena, he became a manager at Ica, the Zeiss subsidiary in Dresden. In 1926 when Zeiss Ikon was formed, Goldberg was appointed the principal director.

In the 1920s the practice of microfilming business records was becoming common. Banks, in particular, found that they could reduce fraud by microfilming checks before returning the cancelled originals to customers.

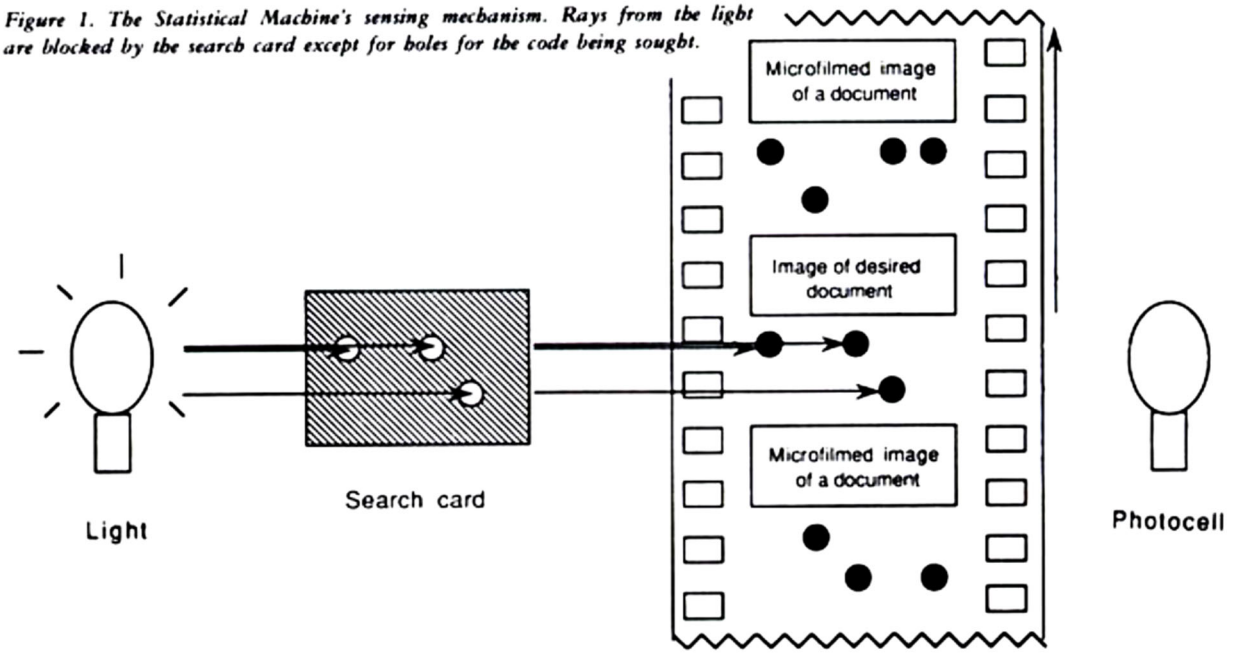
His extensive work on movie camera and projector design familiarized Goldberg with engineering problems in handling 35 mm film. The issue with microfilmed business records was to find and retrieve particular records promptly from long spools of film, which stored thousands of records in no particular order. One could create indexes to the microfilmed images, but that was tedious and yielded only an address for the record, not the record itself.

Goldberg found electronics intriguing. He became actively involved in the development of television technology and enjoyed rebuilding radios as a hobby. In particular, photoelectric cells, central to sound movie technology, became a development of great importance for Zeiss Ikon.

To solve the problem of retrieving individual records from spools of microfilm, Goldberg used movie projector technology to handle the microfilm and a photoelectric cell to do pattern recognition in finding the right record. The principal application, expected to be retrieving accounting and sales data, was called a "Statistical Machine".

The idea is shown in Figure 1. When the documents are microfilmed, they are also indexed. Whatever feature likely to be used for retrieval, e.g. amount of check, account number, sales area, was represented by a code. One could use letters or numbers, but patterns of opaque dots were simpler. The index code was photographed alongside each document, either to one side of the image (like a movie soundtrack) or underneath, as in Figure 1.

Figure 1. The Statistical Machine's sensing mechanism. Rays from the light are blocked by the search card except for holes for the code being sought.



In Goldberg's basic design a "search card" is created and placed between a light source and the film. The search card, blocking all light from the light source, except for a pattern of very small beams, defined the code that was sought.

Beyond the film was a photocell. As the film, containing images of documents, moved through the machine, some of the light that passed through the search card, passed through the film, and reached the photocell, where it generated a low voltage electrical current.

When the opaque dots on the film coincided exactly with the pattern of light beams defined by the search card, all light was blocked and no light reached the photocell. When no light reached the photocell, the flow of low voltage electricity faltered. Circuitry detected the loss of current and signaled the desired document had been found.

A modified movie projector was used with suitable lenses to focus the beams of light onto the film, as shown in the lower half of Figure 2. Another mechanism was needed to project the image of the selected document for viewing or copying as shown in the upper half of Figure 2.

In August 1931 at the 8th International Congress of Photography in Dresden, Goldberg described and demonstrated his machine at one of the smaller technical sessions.

More attention might have been paid to this presentation had the delegates not been excited by Goldberg's other widely reported presentation of sound movie technology. His proposal for an international standard for film speeds, was eventually adopted by DIN and ASA.

When, in October 1931, Goldberg as Taylor Lecturer at the Royal Photographic Society in London demonstrated the Statistical Machine as part of his lecture, he received prolonged acclamation.

Goldberg clearly attached great significance to the Statistical Machine for German patent No. 670,190, December 22, 1938 was issued jointly to Zeiss Ikon and himself. He is said to have negotiated an agreement with Zeiss Ikon to receive a share of any royalties from it.

Goldberg supposedly built two different prototypes that he described a variant designs in which one could dial a code number, like dialing a telephone, instead of using a search card. But

in 1933, Nazis kidnapped Goldberg from the Zeiss Ikon offices. He was released and urged to leave Germany.

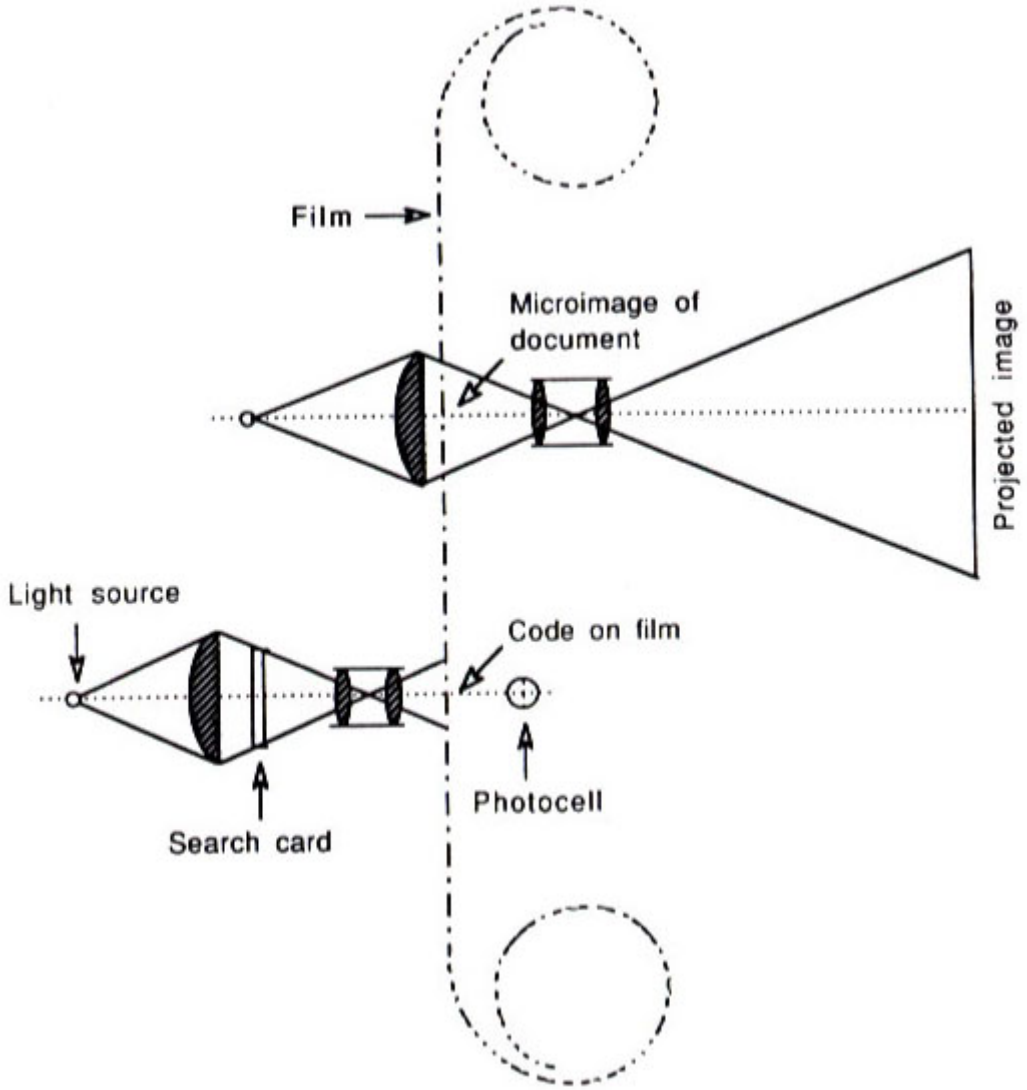


Figure 2. Diagram of the Statistical Machine showing the sensing mechanism and, above it, projection of the image of the document.

In the USA, IBM promptly acquired rights to the U.S. patent No. 1,838,389, issued December 29, 1931. Separately at MIT, Vannevar Bush developed a similar device in the late 1930s with support from Eastman Kodak and from National Cash Register.

Aptly named Microfilm Rapid Selector, the film moved continuously and rapidly without a movie gate. Bush's patent examiner identified the Zeiss Ikon Statistical Machine as "prior art".

In great secrecy, Bush also supervised the development of a variant version, the Comparator, to help Navy cryptanalysts break enemy codes. Its special function located the prevalence of particular characters in encrypted messages.

After World War II, Engineering Research Associates revived the MIT-designed Microfilm Rapid Selector. The development of retrieval machines combining microfilm and photocell continued into the early 1960s when digital computers took over.

Never did the Statistical Machine develop into a Zeiss Ikon product and few traces of it remain. Nonetheless, pioneering achievement and, apparently, the first of its kind began with Dr. Emanuel Goldberg at Zeiss Ikon.

Further reading:

An article an article on the Zeiss Ikon statistical machine, and a translation of Goldberg's original description in Dresden, 1931: *Journal of the American Society for Information Science* (vol. 43, no. 4), May 1992, pp. 284-294; 295-298.

Colin Burke, *Information and secrecy: Vannevar Bush, ULTRA, and the other Memex*, Scarecrow Press, 1994. A detailed account of similar machinery developed in the USA for cryptanalysis and for document retrieval.

Postscript 2024: For a later, more detailed account see Michael Buckland, *Emanuel Goldberg and his Knowledge Machine: Infrmation, invention, and political forces*. Libraries Unlimited, 2006. German editiom: *Vom Mikrofilm zur Wissensmaschine: Emanuel Goldberg zwischen Medientechnik and Politik*. Berlin: Avinus, 2010.