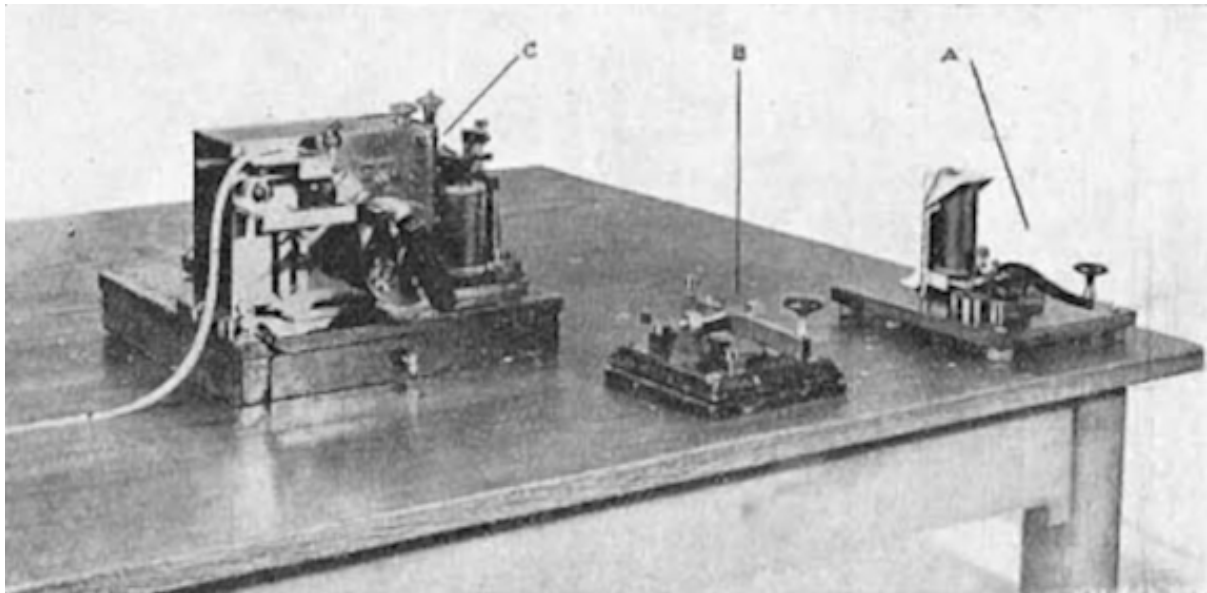


KOCH + FARNSWORTH = BIEGEL

The Sound Picture

How Betty Biegel taught telegraphists to listen - and why the world came to know her method only later, under other names.

A life and a method Dr. R. A. Biegel · 1886–1943
Author: PE1HVV



The instruments used. The automatic Morse keys (A, B, C) with which the training was carried out.
From: R. A. Biegel, Nieuwe methoden... (Waltman, Delft, 1939).

In the signalling room of the Amsterdam training school for radiotelegraphists, around 1930 one merciless measure prevailed: one hundred and twenty-five characters per minute. Anyone who could not reach that speed by ear was dropped - and there were many. Of the carefully selected candidates, the school had to turn away no fewer than 65 percent, almost all for that same reason: the required speed remained out of reach. It looked like a matter of aptitude. But what if it was the teaching method?

That question was posed by a psychologist who rethought Morse instruction from the ground up. Her starting point was as simple as it was unheard of: a telegraphist working at speed no longer hears dots and dashes, but a single rhythmic sound - a *sound picture*. Whoever presents that sound picture from the very first lesson and only gradually shortens the silences between the characters never has to make a pupil unlearn anything. "It is psychologically wrong," she wrote, "when in practice something is first learned that later has to be unlearned."

Between 1931 and 1939, Dr. R. A. Biegel set down that idea in three publications - first a test to find suitable pupils, then a radically new way to train them. The work was ahead of its time, and it would largely fall into oblivion. This is the story of that method, and of the woman behind it.

The three articles and the new method

Three publications by Dr. R. A. Biegel survive from her PTT period:

- **1931** “An aptitude test for radiotelegraphists” (Psychotechnische Zeitschrift, together with J. E. de Quay (the later prime minister)). This is about selection: a non-verbal aptitude test that predicts whether someone will ever reach the high reception speed (125 characters/min). With the Creed transmitter, sound pictures were presented at ever-shorter intervals; from the errors one could read who was “suitable”. In retrospect the test correctly identified 84% of the strong and 70% of the weak pupils.
(see: https://www.pe1hvh.nl/pdf/Biegel_1931_DE_Eignungspruefung.pdf)
- **1932** “The learning of aural reception by radiotelegraphists”,
(see: https://www.pe1hvh.nl/pdf/Biegel_1932_DE_Anlernen.pdf)and
- **1939** “Nieuwe methoden voor opleiding van radiotelegrafisten en telegrafisten” (booklet, Waltman Publishers, Delft).
(see: https://www.pe1hvh.nl/pdf/Biegel_1939_NL_Nieuwe_Methoden.pdf)

The last two describe the actual teaching method.

The core of the new method. At high speed you no longer hear a Morse character as a string of dots and dashes, but as a single rhythmic sound picture (a whole, a “gestalt”). The old teaching method slowed the pace by stretching both the pauses *as well as the characters themselves*. The result: at first the pupil had to count dots and dashes (atomistically), and around 80–100 characters/min he ran into a “plateau” where he had to unlearn that counting in order to switch to whole-pattern recognition.

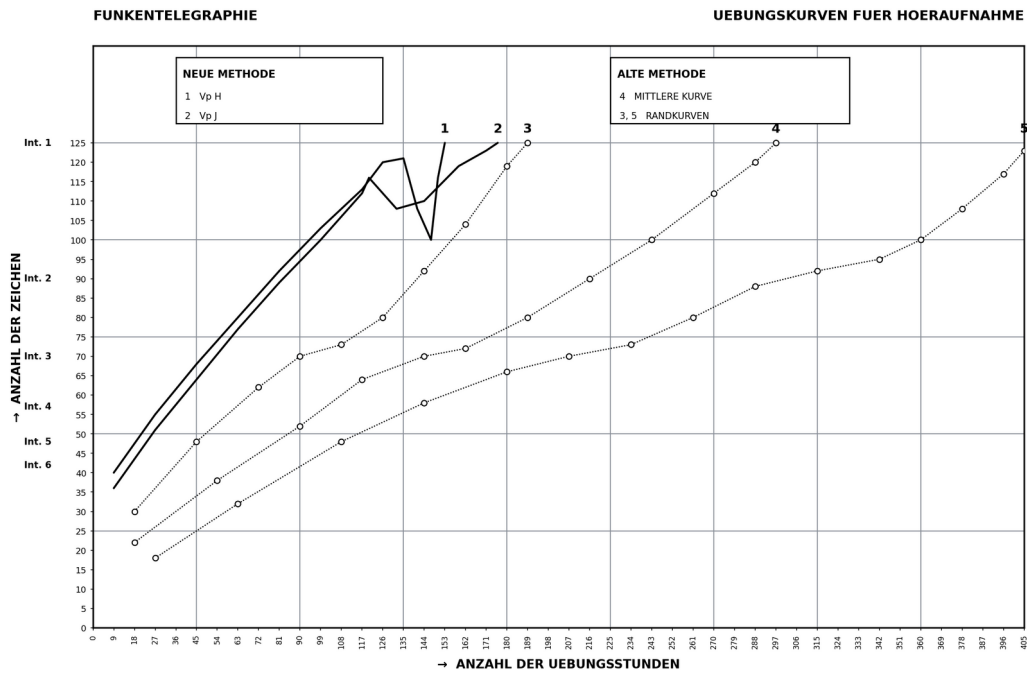
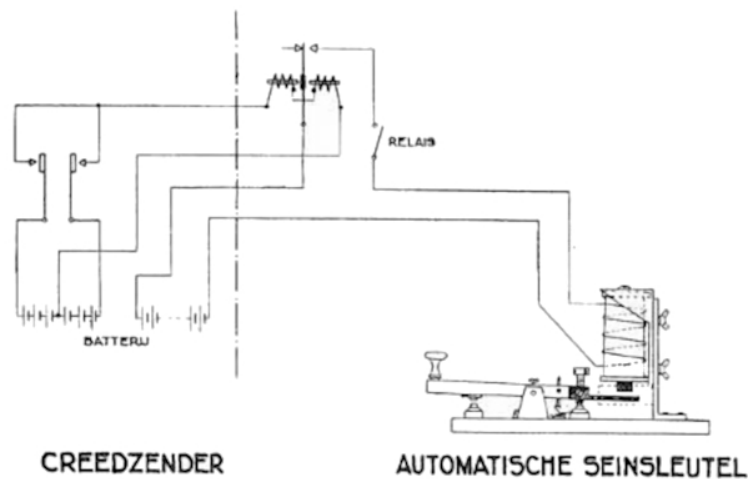


Abb. 1.

The proof in a single graph. The new method (solid lines) reaches 125 characters/min in 153–176 hours; the old method (dotted lines) takes 290–405 hours - with the notorious plateaus along the way.

From: Biegel, *Psychotechnische Zeitschrift* (1932). Public domain.

Biegel’s solution: keep the character in its full-speed form from beginning to end - so always the same sound picture - and initially place the characters far apart with long pauses. Only those pauses are gradually shortened to their normal length. This way the pupil never learns to count and never has to unlearn anything; the plateaus disappear, the learning curve grows steeper, and she measured a time saving of some 40–44%.



The machinery behind it. The Creed transmitter with automatic Morse key that sent the characters at constant speed - the technology that made Biegel’s approach possible.

From: Biegel, *Nieuwe methoden...* (1939).

Why this was groundbreaking for its time. This was empirically grounded didactics, rooted in Gestalt psychology, applied to a technical trade at a time when training relied mainly on habit and experience. Her starting point - learning through

rhythm and sound rather than mechanical counting - anticipated an insight that only became common knowledge in the computer age. And it is, in essence, exactly what we today call the Farnsworth method.

THE WOMAN

Who was Biegel (and the Einstein connection)

Rebekka “Betty” Aleida Biegel (Groningen, 1886 - Westerbork, 1 June 1943) was a Dutch pioneer in applied psychology. But she began somewhere quite different: after her grammar school in Groningen she went to Leiden in 1904 to study astronomy, where she was also chair (Praeses) of the Association of Female Students.¹

After her studies she became assistant to the astronomer Anton Pannekoek and had influential contacts, including Albert Einstein and Carl Jung. According to tradition she went to Zurich to help the struggling Einstein with his proof - this was around 1913–1914, exactly the period in which Einstein was working in Zurich on the general theory of relativity.

From 1914 to 1923 she lived abroad and earned her doctorate at the University of Zurich on star positions in Egyptian art. Recently she was identified, using AI facial recognition, in a famous group photograph from 1913 with Einstein and other physicists. She was 27 at the time.²

Only at the age of 41 (1927) did she begin to study psychology in Utrecht; in 1929 she joined the PTT, built up the Psychotechnical Laboratory (opened 1933), became a private lecturer in Delft and was among the first board members of the Dutch Institute of Practising Psychologists (the later NIP). Her assessment test for drivers was used 34,565 times and was not replaced until 1971.³

Her appointment did not go unnoticed: in 1932 it even led to questions in Parliament. A member of Parliament objected that the PTT had appointed a woman to the rank of referendaris - with a salary of well over 5,000 guilders a year and a generous expense allowance - and took exception to her constant study trips and foreign congress visits (a year earlier even to Moscow). But above all he denounced the hiring of a woman while “so many learned male minds” were walking around unemployed, often with a family to support. The Minister of Public Works brushed the objections aside: the official trips were not so extensive, the salary suited her rank, and the post had simply gone to the person best suited for it.¹⁰

THE LEGACY

Did Koch and Farnsworth arrive at the same method - and inspired by Biegel?

Koch (1936): almost certainly directly influenced.

The German psychologist Ludwig Koch published his famous method at the TH Braunschweig in 1936 (all characters immediately at full speed, starting with two characters and expanding each time). In his dissertation Koch refers explicitly to

Biegel's aptitude test: he notes that she applies a similar test, only with a different starting speed - she begins at 40 characters/min, he himself at 60. Because Koch points this out himself, it is established with certainty that he knew Biegel's work. (In the modern source compilation that brings together Koch's dissertation with the articles of Biegel and Lippmann, the compiler describes Biegel and Otto Lippmann as "his teachers"; that characterisation, however, comes from the compiler, not from Koch himself.) Koch's thesis is moreover strongly oriented toward Gestalt psychology/holism - Biegel's sound-picture idea. Koch thus shared her insight (the full sound picture from the very start, never counting) and demonstrably built on her work.⁴

His substantive objections to Biegel's method concern solely Biegel's aptitude test (1931). Her actual teaching method - the article "Das Anlernen der Höraufnahme" (1932) - appears only in his bibliography and is nowhere criticised. The method he does reject is the general sound-picture method with wide intervals (the later Farnsworth method), but there he does not name Biegel, even though his own "new learning procedure" shares her core insight (the sound-picture method). He criticises only the design of her aptitude test.

Why he rejected that interval approach is telling. According to Koch, the thinking time in the long pause acts as a threshold: as soon as the speed rises, that reflection is no longer possible and the pupil must abruptly switch to direct recognition, which causes a plateau in the learning curve (around 50 characters/min). It is precisely that mechanism - full speed with initially wide, gradually shortened intervals - that would later be called the Farnsworth method. Koch thus rejected what later became the Farnsworth principle.

Biegel, however, claimed the opposite: with her method "the plateaus disappear", she writes in 1939, because the characters are presented as a sound picture from the very start and never as dots and dashes - nowhere is a different conception of the material required. Koch and Biegel thus shared the philosophy, but chose opposite beginner's controls: he selection, she spacing - and precisely on the plateau they flatly contradicted each other.

Farnsworth (1950s): identical idea, but origin unknown.

The American radio amateur Donald "Russ" Farnsworth gave his name to Biegel's approach: characters at full target speed, but with initially exaggerated intervals that provide "thinking time" to learn the sound-"shape" of the letters, then gradually shortened.⁵

That is Biegel from 1932, word for word. Yet direct inspiration has never been proven: in the literature the origin of the Farnsworth method is called "still a mystery". Although Biegel's publications originally appeared in German and Dutch, her method can also be found in American specialist literature (Taylor, 1943).

The American trail.

Biegel's work was not confined to the European continent. In his American review article - D. W. Taylor, "Learning telegraphic code", *Psychological Bulletin* (1943) -

Taylor goes beyond mentioning: he attributes the experimental grounding of the method to Biegel in 1932 and tests it as well. He summarises her Gestalt reasoning - at high speed each character has its own sound picture that the trained operator hears as a single whole; if characters and pauses are stretched together, that pattern falls apart and the pupil goes back to counting dots and dashes - and even records her estimate that this collapse sets in around 16 words per minute. Tellingly, Taylor took the author to be a man: he consistently writes “he”.⁸

And Taylor - a psychologist at Harvard - did not stop at summarising. In his experimental study, “The Learning of Radiotelegraphic Code” (*American Journal of Psychology*, 1943), he taught his classes according to exactly the sound-picture philosophy Biegel advocated - learning to recognise characters as a whole, no visual symbols, no mnemonics - and tested the approach that would later be called Farnsworth (characters at full speed from the start, ± 18 wpm, with intervals gradually shortened) directly against the old, slowed-down method.⁹

By 1943, the scientific approach to code learning - with Biegel as the earliest source - was current within the English-language, library-accessible circuit, a decade before Farnsworth’s name.

MY PERSONAL FINDING

The official origin of the Farnsworth method is considered unknown - “still a mystery”, according to the standard work *Morse Code, the Essential Language*.⁷ But little mystery actually remains. The method - characters at full speed, with intervals gradually shortened - has a scientific trail that begins well before Farnsworth. Biegel described it first (1932). Koch examined it (1936). And the scientist D. W. Taylor tested it in 1943, published this in an American journal and named the origin of this method explicitly - a decade before Farnsworth published the method.

Three names, one method; the best known was that of the last, who added the least to it.

Whether the ham world took the label “Farnsworth” directly from Taylor’s work or reinvented it cannot be determined. But in 1943 Taylor attributed the grounding of the method to Biegel (1932) in so many words - so that she may without reservation be called the very first founder of this method.

Twice her name was lost: in 1943 Taylor took her for a man, and the method she was the first to describe was ultimately named after Farnsworth.

IN CLOSING

A method that lost its advocate

Because of her Jewish descent Biegel was persecuted; when deportation to the Sobibor extermination camp threatened, she and her sister Annie ended their lives in Westerbork camp. The German invasion of May 1940 destroyed precisely the services where her method had been introduced (Soesterberg, the Naval Coastguard, the Signals Service); her dismissal in 1941 and her death in 1943 deprived the work of its advocate. As a result, Dutch vocational training remained stuck on the older counting method for decades, and her early, empirically grounded approach largely fell into oblivion - while virtually the same idea later became the worldwide standard under the names Koch and Farnsworth.⁶

Biegel's method was not a theory but a working method - tested and put into practice. In her 1939 booklet she measures her training against the old counting method of the Amsterdam Telegraph Office, which required on average some 297 hours (189 to 405) with a dropout rate of 65%; against that, her practice curves ran much steeper and she started at a higher level.

And it did not stop at a trial: according to her preface, by 1939 the method had already been introduced at three services - the Aviation Department at Soesterberg, the Naval Coastguard and the Navy's Radio and Signals Service in Amsterdam.¹²

Koch's method, by contrast, long remained theory. It was published in 1936 but introduced operationally nowhere: it requires one-on-one guidance or a machine that each time presents "the known characters plus one new one", and before the personal computer that was practically unfeasible. Only with the revival by David Finley (from 1995) and with software in the 2000s - the G4FON Koch trainer (2002), "Just Learn Morse Code" and LCWO.net - was Koch's method actually applied, about sixty years after publication.¹¹

A tested and practised method against a theory that long lay idle: in application Biegel was not behind, but far ahead.

The picture that emerges is that of an exceptionally versatile woman - from Einstein's Zurich to the psychotechnics of the PTT - whose ideas had to cede their fame to others;

because the war silenced her and her work.

Sources

Primary: Biegel's own articles (1931, 1932) and book (1939); Oorlogsgravenstichting (War Graves Foundation, reg. no. 11831). Secondary and supplementary:

1. **Wikipedia (NL)**, "Rebekka Biegel" - astronomy studies Leiden, Praeses VVSL, life course.
2. **NRC / Headliner** and **Delta (TU Delft)** - Pannekoek, contacts with Einstein and Jung, and the AI identification in the 1913 group photo (research by Chris Verhoef & Jacques Dane).
3. **Delta (TU Delft)** - driver test used 34,565x, replaced in 1971; career PTT/Delft.

4. **Internet Archive** (R. Conder, K4RLC, source compilation accompanying Koch's 1936 dissertation; here the compiler describes Biegel and Lippmann as "his teachers") and **Quentin Santos**, "Learning Morse with Koch" and "Koch's Dissertation on Learning Morse Code" - Koch's own reference to Biegel's aptitude test (she 40, he 60 characters/min) and the Gestalt orientation of his thesis. Koch's own bibliography (Schrifttum) lists both Biegel articles (1931 and 1932), through which the Biegel → Koch link is grounded primarily.
5. **Wikipedia (EN)**, "Farnsworth method" and **OnAllBands**, "Hams You Should Know: Donald R. Farnsworth" - full target speed + wide spacing; origin "a mystery".
6. **Wikipedia (NL)**, "Rebekka Biegel" - persecution, dismissal 1941, Westerbork 1943.
7. **L. P. Carron (W3DKV)**, Morse Code: The Essential Language (ARRL), Second Edition - "The true origin of the Farnsworth Method is still a mystery"; Learning to receive and send 4-3.
8. **D. W. Taylor**, "Learning telegraphic code", Psychological Bulletin 40 (1943): 461–487 - American review article that attributes the experimental grounding of the method to Biegel (1932), reproducing her Gestalt reasoning, and includes both her articles (R. A. Biegel, Psychotechnische Zeitschrift 6 [1931]: 41–45 and 7 [1932]: 147–151), alongside W. L. Bryan & N. Harter (Psychological Review 4 [1897]: 27–53 and 6 [1899]: 345–375) and Koch (1936). Accessible via PsycNET or ResearchGate publication 232588749.
9. **D. W. Taylor**, "The Learning of Radiotelegraphic Code", American Journal of Psychology 56 (1943): 319–353 (Harvard dissertation; full text: http://www.ks0man.org/Harvard_on_learning_code_1943.pdf). Koch had earlier been reviewed by H. Peak, "Koch's Method of Learning Code Reception", Psychological Bulletin 39 (1942): 495. The American code-learning literature continues through, among others, J. P. Seward (J. Exp. Psychol., 1943), Carlson & Rich (Psychol. Bull., 1944) and E. A. Fleishman (J. Appl. Psychol., 1955, 1958, 1960).
10. **Westerbork Portretten** (Westerbork Camp Memorial Centre), "Rebekka Aleida (Betty) Biegel" - written parliamentary questions (1932) about her appointment at the PTT and the reply of the Minister of Public Works; originally recorded in C. Rümke, *Rebekka Aleida Biegel (1886–1943). Een vrouw in de psychologie* (ADNP, reissue 2006), Appendix I: copy of the written parliamentary questions 1932. Directly readable at westerborkportretten.nl/westerborkportretten/rebekka-aleida-betty-biegel; the original document appears in the Appendix to the Proceedings, Lower House 1931–1932, accessible via statengeneraaldigitaal.nl.
11. **D. G. Finley (N1IRZ)**, "So You Want to Learn Morse Code" (qsl.net/n1irz) and Morse Code: Breaking the Barrier (MFJ) - Koch's method requires a computer or a personal trainer and was therefore long overlooked; revival through "Reducing the Barrier" (Radio Fun, May 1995) and "Effective Training for High-Speed Morse" (Morsels, autumn/winter 1996/1997). Practical implementation only with software: G4FON Koch CW Trainer (2002), "Just Learn Morse Code" (S. Stenersen, LB3KB, 2005–2006) and LCWO.net.
12. **R. A. Biegel**, Nieuwe methoden voor opleiding van radiotelegrafisten en telegrafisten (Waltman, Delft, 1939) - preface: introduction at the Aviation Department at Soesterberg, the Naval Coastguard and the Navy's Radio and Signals Service in Amsterdam; Chapter I, §1 and §4: comparison with the counting method of the Amsterdam Telegraph Office (± 297 hours, range 189–405 hours, 65% dropout), steeper practice curves and higher starting speed.

Figures: from R. A. Biegel (1886–1943), "An aptitude test..." (1931), "The learning of aural reception..." (1932) and Nieuwe methoden... (Waltman, Delft, 1939).