The Musical Roots of Morse Code

Clemens Gerke's 1850 book reveals the musical origins of Morse.

By Chris Rutkowski NW6V[1]

Preface

Clemens Gerke was a German musician and linguist who in 1848 invented[2] what we today call "Morse code."

Gerke worked for the German post office and was given the job of establishing an electromagnetic telegraph. He translated Alfred Vail's 1846 *The Electromagnetic Telegraph,* into German, and worked with the fledgling Morse organization there, using equipment provided by the Morse organization.

Gerke's code was born around 1848 to correct flaws he perceived in the original while deploying, staffing, and managing the line between Hamburg and Cuxhaven. His fixes were intended to make it faster, easier to learn and use, and to better support European languages. Gerke's code was not the only proposal, but by 1851 his alphabet became the de facto European standard, known as the *Continental Code,* which was the core of the 1865 *International Code,* which we use today.

Gerke's own book, *The Apprentice Telegraphist,* published in 1851, picks up where Vail's 1846 book, *The Electromagnetic Telegraph,* left off. It focuses less on the historical path by which the telegraph arrived (Vail's focus), and more on the place where they now stood, on the brink of massive deployment. It provides crucial information for stakeholders in government and business, encouragement and practical information for managers and telegraphists, and sound advice for students.

Here, we learn for the first time, in Gerke's own words, that he defined the signals of the code as *half and quarter notes*. Not as measurements in terms of dit lengths, but as the total time it takes to make a dit – including the start and stop.

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[1] https://www.youtube.com/@morsebusters

[2] While "developed" is used, Gerke made fundamental changes in the code, so I consider it invention.

Id figured this out – reverse engineered it - during my study of the code's rhythmic structure. The *beat charts* I developed reveal how a 2:1 rhythm produces 3:1 signals. To paraphrase Gerke, "it can be no other way." It's a central theme of my book, *the CW Way of Life* [Amazon].

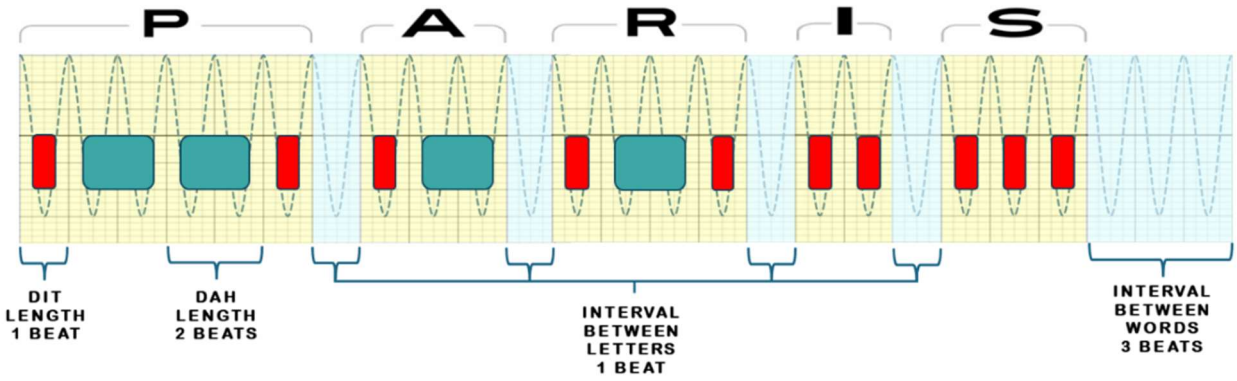

Fig 1: A Beat Chart

But I had no proof. Until now.

I didn't even know Gerke's book *existed* until Dr. Stephen Phillips of *Morse Code World*[3] shared a snippet he'd he'd translated comparing alternative telegraph codes. Stephen said he was thinking of translating more… And he provided a link to the original[4].

Well, as soon as I had that link, I was off and running.

I spent the next few days translating that archaic German script with the help of various AI systems, a native German speaker with a masters in English (who conveniently happened to be staying with me for a month), and the usual pile of editing tools.

What unfolded was a historical treasure.

Along with carefully curated and well-described details about the tools and equipment of those early days, Gerke tells us, *explicitly,* that the timings and spacings of Morse code, the code we use today, are those of quarter and half notes, as in music.

That is NOT taught in any Morse class, nor in any history book.

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[3] https://morsecode.world/

[4] https://www.google.co.uk/books/edition/Der_praktische_Telegraphist_oder_die_ele/pqlAAAAAcAAJ?hl=en

Every source from Wikipedia on down[5] just quotes international *regulations,* which define Morse code as *signals* in a 3:1 length ratio, etc. We accept those ratios as *given;* plug-in formulas provided by the ITU. They are matters of regulation and convenience, not natural law.

Morse is reduced to *mechanics,* divorced from its rhythmic roots.

Historians - and I use the term very loosely in my case – don't get solid confirmations about theories all that often. Gerke's book *floored* me. My b*eat-charts* show the code as Gerke conceived it - *as quarter and half notes against a background beat.*

But does this *matter*?

I hear arguments that many, perhaps *millions* learned Gerke's code without Gerke's viewpoint, which is true.

Morse is taught as a *skill,* like typing, not as a link into your neural net, like music. Some say Morse is *just another mode:* you do code so you can do SOTA[6], you don't do SOTA so you can do code.

But like gravity, the pulls of rhythm are felt whether you know about them or not. Many respond intuitively to those pulls and find the code's rhythms unaided. But some struggle. And some just want to excel.

Personally, I believe, as Gerke puts it, that the *contemplative* mind is better able to accommodate the changes that lie before you. He explains, "A mere writing automaton can never become a competent telegraphist," and, that there is a "magic circle" into which you are being introduced. Welcome aboard.

[5]Not that I consider Wikipedia a primary source, but it is a common place to start.
[6] Summits on the air

MAIN ARGUMENT: *(What did Gerke know, and when did he know it?)*

This section highlights Gerke's "quotable quotes" about keying, rhythm, and the code's musical nature. They make the musical connection clear, and also that Gerke was struggling for words to express these relationships. He needed beat-charts.

Pg 40 a timing measure with which the writing telegraphist must align—indeed, accommodate—his timing of movements."

Pg 58 It is, therefore, (a cycle of) action and passivity regulated by certain laws by which writing is produced.

Pg 59 Similar to those four dots, strokes (dashes) are produced by closing the circuit twice as long, approximately analogous to half notes of music, on which two quarter notes are also to be reckoned;

Pg 78 the hand must not be held stiffly; rather, skill depends chiefly on the wrist, which during writing must be kept in continuous supple motion.

Pg 79 Another important requirement is correct timing: that is, striking and releasing the key in rhythm, so that the proportion between dots, dashes, and spaces is exactly maintained, producing writing that is easy to read at the receiving station.

Gerke explicitly connects rhythmic key motion with "exactly maintained" dots, dashes, and spaces, as revealed in beat-charts.

Pg 80 As a general standard, the dots—regarded as the basis of rhythmic movement—should be made in their normal sequence like the ticks of a small pocket-watch, when they are used as parts of the same letter. Each dash may be given the duration of two, or even three, dots; thus, when making a dash, the key should remain closed for as long as it takes to make two or three dots.

In the context of Gerke's comments about "rhythmic movement," "as long as it takes to make two or three dots" is in relation to rhythmic movements – otherwise he's changing metaphor in mid-paragraph. He goes on to say:

Should a pupil happen to have a grasp of music, one may compare the dots to quarter notes, dashes to half notes, the space between two letters to a quarter rest, the space between words to a half rest.

The space between two dots, or between a dot and a dash, or between two dashes, is formed properly by the opening and closing of the key,

Again, Gerke points to the "opening and closing of the key" – which we know is "rhythmic."

The foregoing was all written for his 1851 book and can be said to represent his best and current thinking. However, the following section, from the *About the Written Language* section, was reproduced from an earlier publication by Gerke, and focused on the advantages of one alphabet over another. It does say:

Pg 90 It is, in fact, a rule that the duration of one dash is to be reckoned as equal to that of two dots, and in practice it is common to take somewhat more.

Pg 92 If, moreover, I were to be strictly just, and assume three dots for each dash, as is done in practice by every good telegraphist, the impracticality of Steinheil's alphabet would become even more striking.

Not one word about regularity of keying, or musical relations. No reference frame is provided. But this was written *before* the labor and experience that led to *The Apprentice Telegraphist*.

But even then, comments like "as is done in practice by every good telegraphist" imply a dawning awareness that natural rhythms guide the expert. But he has not yet voiced those thoughts.

Translation Note:

Chapter 1, Batteries. Pg 4-6

"I won't attempt here to explore the inner mysteries of Galvanism—and its intimately related forces, Electricity and Magnetism[7]—which, until now, we can only grasp through their effects.

Instead, I'd like to briefly offer my personal perspective: these three forces, deeply connected at their core and essentially unified in origin, represent—more likely than not—the true, veiled spiritual principle of life and formation throughout vibrant, living nature.

It is through these forces that all living beings, ourselves included, come into existence and evolve. And it is from these same forces that the atmospheric phenomena—wind, rain, snow, hail, clouds, whirlwinds and waterspouts, and above all, the electric majesty of storms and fiery displays in the skies—find their source.

Even some inorganic creations—like the ongoing formation of gemstones in Earth's depths—likely owe their origin to this universal natural power. Bold thinkers have even speculated that these forces might play a role in the orderly motion of celestial bodies.

In this light, the beating of our hearts, and in their subtlest expression, even our thoughts and emotions, may ultimately be entwined with electromagnetism.

One thing is certain: the cohesion of matter—the very connectedness of things, in the most literal sense—is a daily yet wondrous manifestation of these forces, clearly demonstrated in the artificial process of galvanoplasty[8]. Yes, if we dare to trace fire—and by extension, the primary conditions of life: light and warmth—back to electro-galvanism, then the endless

[7] To galvanize is to "charge something up," i.e. instantiate it

[8] Electro-typing, much like electro-plating but used to great duplicates as in printing processes.

cycle of decomposition and recombination, the constant transformation of the material world from basic elements into complex forms; from decay to the glittering splendor of a flower, a fluttering butterfly, even the radiant structure of humanity—and then back again to decay—is all the work of these shadowy, earthbound spirits. It's a thought fit for endless reflection, mentioned here only in passing, to attune the contemplative mind to the 'magic circle' into which electromagnetic telegraphy will lead it—less through imagination, and more through tangible reality—in the pages that follow."

> This in a chapter on *batteries?* Gerke aims to "attune the contemplative mind to the 'magic circle' into which telegraphy will lead it."
>
> I had a deep sense of déjà vu when I read this; like reading notes I'd left for myself 175 years ago. Pow.[9]

Chapter 3 - The Writing Apparatus Pg 39-40

"Now that the printer and its pen have been sufficiently explained, we pass on to the paper.

Because the pen, or more precisely, the key, is not fully mobile like the human hand, and can only move up and down, it was necessary instead to move the paper to prevent things from being written over each other. This can be visualized as follows: if our hand or arm and the pen were clamped in a block, so that we could not move it from left to right, and we still wanted to write, the paper would have to be pushed or pulled evenly from right to left under the tip, to properly space the letters.

This immobility of the key thus creates two requirements: namely, the movement of the paper tape in the printer itself, and uniform movements, according to a timing measure with which the writing telegraphist must align—indeed, accommodate—his timing of movements."

[9] See the sections on "The Morse Cycle" near the end of my *Perception and Experience of Morse* video.

That "timing measure," is shown by the squiggly line on beat-charts. The beats are the *rails* for the "dit-train."

Gerke says you must not only *align* with, but "accommodate" the timing measure. *Accommodate* means; "giving it a place to live." i.e. in modern parlance, to *internalize* the timing. We not only *make* signals, we become *entrained* by their flow.

Chapter 4 – The relay Pg 58-59

[Speaking of the rapid opening and closing of a relay] "… telegraphic writing is nothing other than a continual opening and closing of the circuit, whereby- depending on the longer or shorter intervals between them, the closures produce dots or dashes, and the openings produce smaller or larger spaces between those elementary signs.

It is, therefore, (a cycle of) action and passivity regulated by certain laws by which writing is produced.

If, for example, *Cuxhaven* station opens and closes the key four times in quick succession; about as if someone were to play four quarter notes on the fortepiano,♩♩♩♩, the armature at each relay of the line will strike up and down four times, in consequence of which the two platinum contacts of each also strike in the same way, and again through the chain of the local battery, which has been interrupted four times and restored four times, the force will pass through the electromagnets of the printer and make its armature move up and down four times as well. And with each stroke the stylus is pressed against the paper moving on its roller, so that there are four dots on the paper strip next to each other.

If the paper moves along while the key is held down, a long dash will be produced, its length determined by how far the paper moves. Conversely, with the key open a gap of equal length will appear, i.e., no mark will be made on the paper.

Finally, as each of these four strokes are made, the extreme end of the printer's pen will strike loudly on the head of the front pillar, so that it can be heard at a considerable distance, and therefore no bell is needed to perceive the signal.

But I chose this signal of four strokes, because in our alphabet it means the letter **H**, which in turn has the meaning "Station Hamburg" for our line, consequently as soon as we hear this signal, we (Hamburg) must then free the clockwork to advance the paper and write whatever the caller sends next.

For the time being, it does not matter from whom the call originated; we only replied with "**I I**" (aye, aye) and one's own station sign.

> Gerke lays out the origins of *a protocol* he defines later, but of interest; "I J (aye, aye)" was "J J (Ja, Ja)" in the original.

Similar to those four dots, strokes (dashes) are produced by closing the circuit twice as long, approximately analogous to half notes of music, on which two quarter notes are also to be reckoned; and from these dots and dashes, as elementary signs, the letters are then put together, as we shall see later in the alphabet.

> Gerke again confirms the relationship of dots and dashes to quarter and half notes. This is not how it is taught. It confirms the rhythmic relationships.

A finely trained ear can now distinguish every letter by the sound, even read words, and this even at the relay, which in itself gives a fine sound.

> Gerke 100% confirms that "copy by ear" was a thing by 1850 when this was written! This is another "rewrite the history books" revelation – the date is frequently placed later, sometimes as late as the civil war. The relay predates the "sounder."

I would like to remark here in passing that in our arrangement the writing station, by engaging its clockwork and letting the strip of paper run, can see what it has written itself; especially useful in the

case of difficulties presented by the line, setting up another machine, introducing a new roll of paper, setting up a new line, etc. This is of particularly great advantage when sending numbers, to confirm their correctness without inquiry or repetition.

Even the student can use this to observe and verify their own writing.

> The tape's ability to authenticate what was received was a crucial patent claim of Morse's system. However, Gerke points out the value of seeing what was sent – particularly for students. Today's students are still advised to record their own sending.

Chapter 7 Using the Apparatus Pg 78-81

I repeat here first of all that it is absolutely necessary to make every telegraphist thoroughly familiar with the principles of electromagnetic telegraphy in all its aspects. He must not only know *that* something is so, but also *why* it is so, and why it must be so. A mere writing-automaton will never be a capable telegraphist; and learning the letters alone, even if accomplished to perfection, by no means produces a competent operator—although a skilled calligrapher (for in telegraphic writing there is calligraphy just as in any other form of writing) has a considerable advantage from the outset.

> In the vernacular of 2025: constant ICR training does not a competent Morse operator make. *Morse is more than one skill.*

It is therefore necessary to lay a sound foundation for this even in the very first lessons, and one must therefore choose as instructors only such officials as are themselves able to perform competently, and who also know how and why they do it in the particular manner they do;

> Instructors must know both how and why the code works.

Conversely, students should be selected who already write well with a pen,

i.e. competent in the English language skills Morse requires.

and above all, before they are placed at a machine, they must know the telegraphic alphabet perfectly, for any pausing to think while producing a letter can and must not be allowed.

The first requirement at the beginning of instruction—just as when a child first takes up a pen—is that the two forefingers and the thumb should not be bent, but rest extended in a supple position upon the key's knob.

The knob, therefore, should not, as some mechanics have done, be made in the shape of a melon—long and tall, but should have the form of a smooth surface, rounded at the top edges, and preferably made of ivory.

The three working fingers must not grasp this knob tightly or clutch it anxiously, but rest upon it with the arm extended and moving freely.

> Here is the first occurrence of suggesting a hand position "just as when a child first takes up a pen" grasping a pen (quill)," with the arm "extended and moving freely."

The second requirement is to make the pupil aware that the hand must not be held stiffly; rather, skill depends chiefly on the wrist, which during writing must be kept in continuous supple motion.

For each dash, the forearm sinks slightly, and in making dots should rise again. This produces an elastic touch, the opposite of which is a stiff pressing or squeezing key lever, which results only in illegible and uneven writing.

The so-called "firm execution"—where each character is distinct and well-spaced on the paper strip – is achieved only in the former manner.

Now since nearly every pupil, as experience shows, willingly becomes accustomed to pressing with bent fingers and later has difficulty weaning off it, one must from the very first lessons insist seriously on preventing this objectionable habit from arising.

Writing by bending the fingers is a bad habit. The forearm and wrist work together to make the signals.

Another important requirement is correct timing: that is, striking and releasing the key in rhythm, so that the proportion between dots, dashes, and spaces is exactly maintained, producing writing that is easy to read at the receiving station. This requirement should first be made as clear as possible to the pupil, and from the outset the practice should be governed by the exact rules on which it is based.

Gerke explicitly states that "striking and releasing the key in rhythm" creates correctly proportioned, easy-to-read code and that this should be taught from the start. I agree. See my book and videos…

As a general standard, the dots—regarded as the basis of rhythmic movement—should be made in their normal sequence like the ticks of a small pocket-watch, when they are used as parts of the same letter. Each dash may be given the duration of two, or even three, dots; thus, when making a dash, the key should remain closed for as long as it takes to make two or three dots.

Gerke says dashes are key-down for "as long as it takes to make two or three dots." This may have contributed to later confusion when specifying Morse by its "signal durations." But he's speaking in the *context* of "striking and releasing the key in rhythm," so "as long as it takes" includes the off as well as the on time.

The space between two letters should be at least equal to the time (or rather the space) of a dot; the space between two words should be the length of a dash.

These are readily seen on a beat-chart. Word-spacing was increased to the current value in 1949.

Paragraphs of writing are marked by a long series of dots; likewise an error, where one must strike out what was last written, is indicated by a series of dots—i.e., at least more than six in number.

This clarified a number of things; see discussion on page 20.

Should a pupil happen to have a grasp of music, one may compare the dots to quarter notes, dashes to half notes, the space between two letters to a quarter rest, the space between words to a half rest.

The space between two dots, or between a dot and a dash, or between two dashes, is formed properly by the opening and closing of the key, and—with correct, not sluggish movement of the clockwork—it is impossible to make dots so quickly that no spaces appear between each element and the next.

At times of interference and also over very long distances, it is necessary to write quite slowly, firmly, and with clear expression.

Gerke again explicitly defines the code in musical terms and specifies that proper inter-signal spacing is accomplished by opening and closing the key – in what I termed *key-cycles,* that is, on the beat.

Gerke repeats advice given to every Morse operator today: *under challenging conditions, you must adjust speed and improve the clarity of your sending.*

A common fault among pupils is a trembling, poorly accented striking of several dots in succession; or a too-light striking of dots, especially a single dot or a pair of dots before a dash, such that they are as good as swallowed. Learners also tend to leave too large a gap between a dash and the following dots, particularly in certain letters (such as D); or too large a gap between two separate dashes; or to hold the last dot in a letter too long. The instructor must watch for these bad habits from the very beginning and work to eradicate them before they become fixed.

Learners have the same problems today. The solution is still as Gerke says: rhythmic key operation creates good code.

In general, it is necessary to strike the elementary signs calmly and firmly one after another; the key must be firmly closed with each stroke and here the aforementioned so-called supple manipulation is useful.

He reiterates, regular, steady, harmonic keying as basic. But it is also *strong.* We were not called “brass pounders” because we were gentle about it.

With imperfect, only light touching of the platinum contacts on the key, the signs–especially the dots–transfer incompletely, or indeed not at all, and the writing naturally becomes illegible as a result.

> Tentative, mechanical keying becomes illegible.

Altogether, however, composure, reflection, and patience are estimable and nearly indispensable qualities for a telegraphist. Impatience, haste, discouragement, and especially forcing the work when difficulties arise, only make the trouble worse.

As soon as the ability to write correctly and neatly (beautifully) has been acquired, and young literate people learn this in four or six weeks with diligence and good instruction, it becomes necessary to consider the proper setting up of the apparatus and the adjustment of its individual parts. However, only approximate, not universally applicable, rules can be given in advance.

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On all the occasions mentioned above, the dashes almost always come more or less distinctly, since the impulse is not so quickly cancelled out as in the case of the dots, and for this very reason it is also customary to have a long series of dots made by some outstation in an effort to eliminate the cause ("make dots", as the Englishman says).

> Gerke observes that dots are harder to distinguish than dashes, so sending a long series of dots allows the receiving end to “tune” their relays and printers for best copy.

Incidentally, it goes without saying that with every obstacle that occurs, the connections must also be checked, especially at the locking screws, or whether naked wires, especially at the local line, touch each other. If, in addition to the dots, even the dashes are omitted, then one or the other, or more of the above-mentioned causes, must be combined and regarded to an increased extent as a cause, and then appropriate measures must be taken against them.

The following *About the Written Language* section starting on page 90 reproduces an article Gerke wrote previously, in the 1848-1850 timeline.

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"The advantage of one alphabet over another is to be measured—besides by certainty of comprehension—only according to the greatest possible saving of time to be used in telegraphing the same. And therefore, during the initial conception of ours, alongside the setting forth of all possible combinations of 2, 3, 4, and 5 elements, I first determined which letters, in a text, are used most frequently on average—which one learns best from experienced and practiced typesetters—and according to this finding, I then used for those occurring most often the simplest number of elements.

Gerke tells us that he repeated letter-frequency evaluations as Morse and Vail are said to have done. His initial motive was to create an efficient and comprehensive alphabet, and no musical motive can be assumed. But later, in practice, Gerke found rhythms relevant to learning and using the telegraph.

Now, with the tendency toward time-saving, it is not only a matter of the number of elements to be used, but also—and indeed particularly—of the duration of time needed to form each individual one of them when telegraphing; and it thus becomes immediately evident that much more time is needed for a dash than for a dot. It is, in fact, a rule that the duration of one dash is to be reckoned as equal to that of two dots, and in practice it is common to take somewhat more.

Gerke again confirms the correct relationship of dots and dashes. But how he's measuring is ambiguous. Is "duration" the length of the *signal*, or the length of the beat?

It was therefore necessary, in designing the alphabet, to pay particular attention to employing dots and reducing dashes–a point which Professor Steinheil evidently did not consider at all, and for which reason his design proves to be thoroughly misleading.

Gerke. Dreierlei Zeichen.	Steinheil. Zweierlei Zeichen.	Morse. Viererlei Zeichen.
1 . – – .	1 . – – –	1 . – – .
2 . . – . .	2 – . – –	2 . . – . .
3 . . . – .	3 – – . –	3 . . . – .
4 . . . . –	4 – – – .	4 . . . . –
5 – – –	5 – . .	5 – – –
6	6 – . . .	6 . . . . .
7 – – . .	7 . – . .	7 – – . .
8 –	8 . . – .	8 – . . . .
9 – . . –	9 . . . –	9 – . . –
0 – – –	0 – – –	0 – – –
A . –	A – . –	A . –
Ä . – . –	Ä	Ä
B – . . .	B – . . –	B – . . .
C – . – . .	C – – .	C . . .
D – . .	D – .	D – . .
E .	E –	E .
F . . – .	F – . .	F . – . .
G – – .	G . . –	G – – .
H	H . –	H . . . .
J . .	J .	J . .
K – . –	K – – .	K – . –
L . – . .	L . – –	L – – –
M – –	M . . .	M – –
N – .	N . .	N – .
O . – . . .	O – – –	O . .
Ö . – . . .	Ö	Ö
P	P . – – .	P . . . . .
Q – – . –	Q – – .	Q . . – .
R . – .	R – –	R . . .
S . . .	S – – . .	S . . .
T –	T – .	T –
U . . –	U . – .	U . . –
Ü . . – –	Ü	Ü
V . . . –	V – . .	V . . . –
W . – –	W . – . –	W . – –
X . . – . .	X	X . – . .
Y – – . . .	Y	Y . . . .
Z . – – . .	Z . . – –	Z . . . .
Ch – . – . .	Ch	Ch
? . . . – . .	Sch – – – –	& . – . . .
152	111	119

Fig 2 - Gerke provided this table comparing his alphabet with that of "American" Morse, and Steinheil.

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Steinheil's alphabet has, as shown above, no advantage at all with regard to the saving of time, and this is really the only thing that matters. -- Nor are Steinheil's combinations arranged according to the practical experience of the typesetters about the most common use of the letters, whereby in the long run again enormous losses of time arise. For example, I refer only to our **e** (.), a sign that Steinheil has chosen for the **i**; but I ask: which of the two vocals

occurs more often: the **e** or the **i**? and for which letter the simplest possible character had to be taken?

Just count both letters on a single page of a book and the answer will surely be in our favor. If, moreover, I were to be strictly just, and assume three dots for each dash, as is done in practice by every good telegraphist, the impracticality of Steinheil's alphabet would become even more striking.

> *Three times what?* "Later, when he wrote the book, Gerke makes the music-like proportions of the code clear, so this should be interpreted through that filter.

- - - - - - - - - - - - - End of *About the Written Lang*uage section – back to 'book time.'

It may finally be, especially for new telegraph enterprises and their officials, useful to set out the technical terminology and the conventions required for mutual coordination, as we have partly inherited such from America, partly have ourselves developed and adopted in the course of time. There are only a few of these, and therefore no alphabetical arrangement is necessary:

Work – Common expression for telegraphing; thus, for example: "it works poorly today," i.e., there are difficulties in telegraphing.

> Radio operators still say they have "worked" each other or are going to "work DX" today. This is the first clue to the expression's origins I've seen.

Send, hand over, or work away – To telegraph a dispatch to an outside station.

Receive – To write down a dispatch that is being worked in from an outside station.

Let run off – Let the paper tape run off.

Answer – Return the attention signal after a call has been made.

Hear (not hear) – Promptly return the attention signal after a call (or do not return it, hence: "they do not hear!").

Write (write a bit!) – For telegraphing.

Strike – The dropping of the armature onto the magnets.

Synchronize (it is not synchronized!) – The simultaneous or non-simultaneous striking of the armatures on the relay and the recording apparatus.

Transmit – The transfer of force from the relay to the recording apparatus.

Range – A relay has much range when the **coils** (*Knäule* = wire windings) develop considerable force, so that the spring can be tightened and loosened for a long time without the recording apparatus ceasing to strike.

Tighten – Namely, to tighten the spring on the relay.

Loosen – To relax the spring on the relay.

Work firmly – To press the key hard when working, so that each elementary signal at the receiving station comes out clearly.

Work so – The silver part (*Argentheil* – unclear; possibly “Argentheil” = “argent part,” referring to the silver contact surface or silver-alloy contact in the telegraph key).

Rub – When the relay fails, i.e., when it refuses to strike up and down exactly and instead remains lying, producing dashes on the paper.

Interrupt – To open the key during reception as soon as the writing, or a single part thereof, cannot be read.

J. J. J. (the English “aye, aye, aye,” or rather Y. Y. Y.: “Yes, yes, yes”) – Understood.

R. R. R. (*repeat*) – Not understood! Repeat!

F. F. – Continue (after repetition of the last word understood, and after an interruption has occurred).

G. G. G. – All stations! (To call all stations when there is news of general interest, e.g., political news or important events.)

Furthermore, the following should be noted: Before beginning work, the telegraphist produces a rather long series of dots; and the same is done when the writer becomes aware during the work that an error has been made. After the dots, he then repeats the last correctly given word and continues the text thereafter.

Officially, an eight-dit string is still the signal for an error. This may be the earliest documentation of its use.

But I'd never heard of it as a sending preface until now.

Back in the early 60s I heard "strings of Es" (like the Es in 'need') used on the air by commercial and government systems as a preface to transmissions but never connected it with a protocol. Gerke tells us a dit string was used as a "call to order," like a music conductor tapping on the music stand, to get all the musicians on the beat.

Because that protocol was never specified, it's use is sporadic and inconsistent. It survives today among some experienced Morse ops, who instead of sending continuous dits as an "error" signal – send a few "E"s followed by the word, just as Gerke directed 175 years ago.

This is an example of how the telegraphist must, as Gerke put it, "accommodate" the beat. You don't bring the rhythm to the party – the rhythm brings *YOU* to the party. It's your e-ticket for Gerke's "magic circle."

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Thus Morse's system once again justified itself as unsurpassed, and when one can telegraph as quickly as one writes with a pen, one would think that all desirable things had been achieved.

Gerke once again confirms that telegraphic sending is as fast as one can write with a pen. This implies something around 20 WPM as a baseline.

To the realm of wishful thinking, however, belongs a news story recently received from New York, of an invention in which whole columns of text telegraphed in a moment. Although this news report suffered from internal contradictions, for example, that its user could write with oil paint, etc., a commission was immediately set up in Brunswick to examine the invention. Their verdict was that it was of great importance as a theory, and worthy of further research, but in practice, it offered no benefit, since the alleged successes were not easily repeatable, despite all the care taken.

However, the improvements in electro-magnetic telegraphy that are still being sought remind us of the many voiced efforts to improve the musical staff. They failed because of the perfection and expediency of the existing system, and in spite of all the praises of newly invented and supposedly better systems, the old has not yet been suppressed, and will probably maintain its prerogative for all time, since it corresponds perfectly to its purpose.

We are left with a final puzzle. Gerke is aware of the alternative telegraph systems that want to displace Morse. But he asserts that Morse is so perfectly suited to its purpose that it will be around for "all time." Was this just hyperbole? Was he dismissing the inevitable advances in technology?

Alternative technologies shared one goal in common; they tried to eliminate *us;* highly trained operators. We were seen as a *problem* to solve.

But out at the network *edge,* where systems were least reliable and conditions least predictable, the one single indispensable component that made the telegraph *work* was *us,* the operators. Our *brains* made the telegraph *smart*. And so, at the edge, the telegraph remained indispensable.

Until we invented satellites and computers and *eliminated* the edge.

Commercial and Government use of Morse ended in 1995, ending Morse's 145 year run as a blue chip. But here's what the accountants didn't count on; Morse is *fun*. Firing up those vibration engines lights up parts of your brain you didn't know you had.

That's why there has been such a broad resurgence of Morse.

It's not just *another* mode. It's music.