# A Homage to Long Scales
# or
# When Size Does make a Difference!

*Long Scales are an alternative to just stretching out a scale for more accuracy*

## How did it all begin?

The name *Long Scale* for a type of slide rule was conceived and coined by American collector **Edwin** (Ed) **Chamberlain** in 1999 [1]. Sadly and unexpectedly Ed passed away in 2017 but he was a lifetime champion and enthusiastic promoter of this innovative form of specialist slide rule [2, 3]. This homage is an attempt to fill in some gaps in the concept that Ed never got around to plugging.

The idea behind Ed's concept was not new but came to the forefront in the early days of gauging at the start of the 18th Century [1]. Then makers started to realise that the precision attainable with such calculating aids was proportional to how long the scales were and how accurately they were subdivided into *tick marks* or graduations. To increase their market share or to outshine competitors, many slide rule makers produced specialist models. Puzzlingly "Long Scale" never became a proprietary name for a type of special slide rule like as, for example, the ubiquitous *Electro*. Nevertheless many specialist long-scale types made it onto the market.

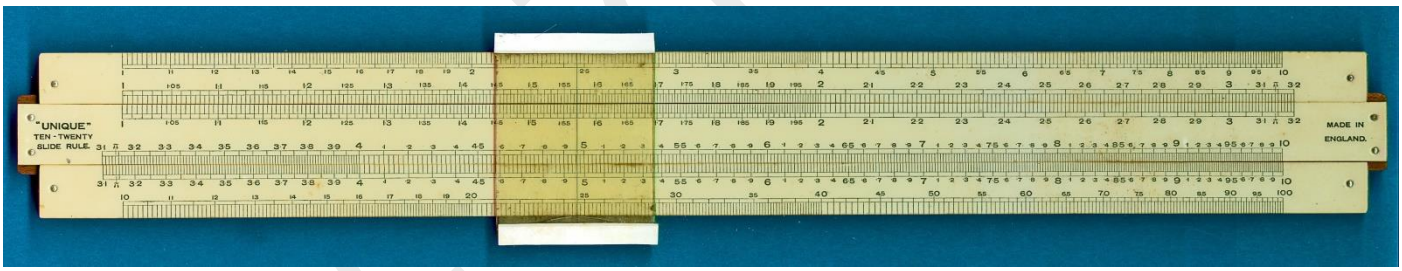


**Figure 1: UNIQUE 10-inch (25 cm) model Ten-Twenty with long scales & a double length square scale**

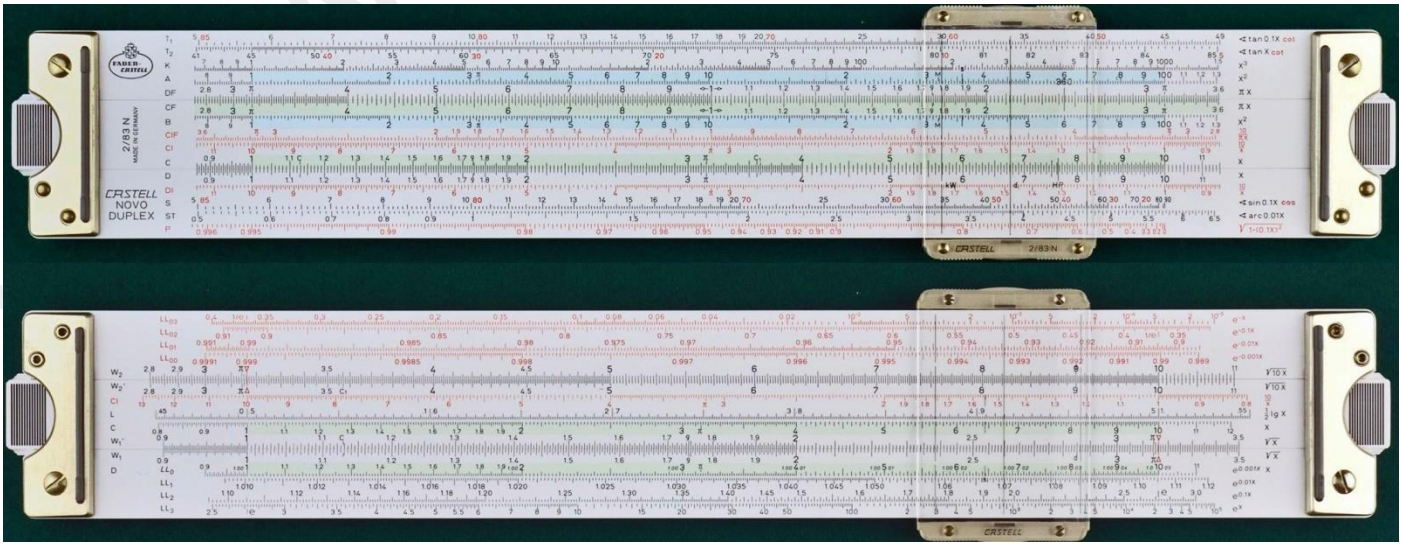


**Figure 2: Faber-Castell 10-inch (25 cm) complex duplex model 2/83N with long scales on the back**

These two strikingly different but same sized examples show the degree of diversity. *UNIQUE* was a maker of budget priced slide rules whereas *Faber-Castell* (F-C) was a high-end maker. Nevertheless, both makers had several long-scale models in their portfolios.

## The benchmark

As is often the case, a credible concept needs a base benchmark and an unambiguous definition. From the outset Ed insightfully chose two crucial benchmark elements to underpin his concept:

- a **10 inch** (25 cm) **linear** scale length
- only the **primary** scales for multiplication and division qualify – i.e. the single cycle standard **C** and **D** scales

The scale length largely chose itself as throughout its heyday the commonest slide rule format was a linear stock with a scale layout including 10-inch long C and D scales. Limiting the qualifying scales to just C and D also ensured the concept did not become too generic or a "catch-all" for too many radically different designs. For example, this criterion excludes slide rules with extra-long trigonometric scales that, at a stretch, can also be used for multiplication and division.

## Accuracy versus precision

Using the benchmark 10-inch slide rule a calculation **precision** of 3 significant digits, sometimes 4, is possible. However, it is important to differentiate between precision and accuracy. Oversimplified precision is the degree of confidence of **how exact** the calculated result can be. The most obvious aid to precision are the tick marks added to almost all scales. For example, richly graduated scales can help with interpolation when the cursor hairline falls between two tick marks. This is also why accessories like magnifying cursors became popular. However, just because they helped improve precision of interpolation, including such an accessory on a slide rule **does not** alter the accuracy of the underlying scales or turn it into a long-scale type. This truism is also why it has always been preferable to use C and D scales for multiplication or division rather than the compacted but less accurate 2-cycle A and B square scales.

## The definition

Long scales are an alternatively designed pair of C and D scales offering greater precision **without** just making them a bit longer. This is because simply stretching out an existing 10-inch single cycle C or D scale without adding more tick marks does not make it more accurate and tellingly does not improve the precision of any calculated answer [4]. A longer but otherwise unchanged scale is easier on the eyes for interpolation of the last significant digit but otherwise offers nothing beneficial. So long scales are defined as:

*single cycle primary scales for multiplication and division offering more precision than comparable scales of the same physical length*

The aptly named *Ten-Twenty* long-scale model from UNIQUE shown in Figure 1 succinctly reflects the definition. On this model the first half of the C and D scales

have taken over the traditional position of the A and B scales. This means the "C and D" portion can now follow on and start halfway along their normal 1-10 logarithmic range. The result is 20-inch long C and D scales on a 10 inch linear stock. It is less obvious but significant for the concept, the normal number of tick marks for the C and D scales scale has doubled. This means a common 10-inch linear long-scale slide rule can now **outperform** sibling models of the same size in multiplication and division – even one made by UNIQUE.

## Tipping-point

Despite Ed using every opportunity to promote the importance of long-scale models the tipping point came in 2013 with the development of an online *Long Scale Rules* search facility [5]. This brought the concept to the attention of many more collectors and became part of a family of unmissable online aids developed by British collector **Rod Lovett** [6]. For over a decade Ed had captured in a spreadsheet the details of every slide rule he felt deserved the accreditation *Long Scale*. This provided a rich data source for the search facility but not unexpectedly with a compilation put together in an ad-hoc embryonic fashion over many years, it had inconsistencies and inaccuracies. After using the facility, I pointed out to Rod and Ed some glaring mistakes in the data and this is when I first got involved. From the outset Ed always had new projects on the go and was busy running his farm. Consequently he could never find the time to clean up the source data Rod imported into his facility. So in 2016 I accepted Rod's invitation to rationalise, supplement and restructure the more than 300 existing entries into a new bigger archive of 11 discrete tables. Ed never explained his rational for needing 11 tables but I retained the original structure. Not unsurprisingly Ed also owned the largest collection of long-scale models – especially the rare ones. Providing some missing images for the new archive tragically stayed on Ed's "to do" list right up to when he died in 2017.

## Plugging the gaps – the tick marks and multiple segments

Ed recognised the importance of the shape and density of the tick marks played in his concept. However, in his published articles he only had space for a few examples. Consequently in 2018 Spanish collector **Jose Fernández** published an extensive follow-on expose of the long scale concept with a particular focus on the tick mark and multiple segment aspects [7, 8, 9]. This cleared any related questions some collectors might have had.

## Plugging the gaps – the formats

The reference model had a 10-inch linear format. However, it was not always obvious how this base case should be extrapolated or applied to other sizes and in particular, other common formats of a slide rule. Poignantly when referring to desktop models Ed wrote: "*They may be the subjects of another paper*" [2, 3].

### *Linear models*

The main generic sizes needing qualification are:

- pocket 5 inch (12.5 cm) models

- desktop 20-40 inch (50-100 cm) models
- demonstration 40-80 inch (100-200 cm) models

Despite the concept being called *Long Scale* and providing they meet the definition, shorter than 10-inch linear models are not a contradiction in terms. Not many examples exist but most long scale pocket models mirror a longer 10-inch sibling. Again the model most succinctly reflecting how this shorter format can be a long-scale type is from UNIQUE – the aptly named *Five-Ten* pocket type, the smaller version of *Figure 1*.

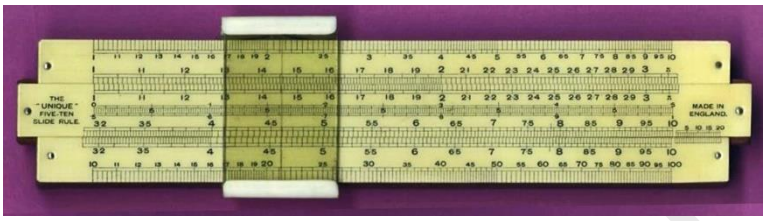

**Figure 3: UNIQUE 5-inch (12.5 cm) model Five-Ten**

The trickiest sizes to rationalise are the desktop models. Because of its length I assumed any 20-inch desktop would be a long-scale type. This is not the case because surprisingly most makers of desktop models simply lifted and enlarged the scale layout from a shorter sibling to make a longer desktop version. So although longer, the underlying scales were just stretched along the length of a longer stock **without** significantly increasing the density of the tick marks or importantly redesigning the layout for multiple segments – a missed opportunity. This is why all the desktop models from the F-C 4/xx/3xx and 4/xx series' do not qualify as long-scale types. However, F-C redeemed their desktop long scale credibility with their 20-inch model 342 *Columbus System Rohrberg*. This model and other desktops that qualify have multiple segments. This just leaves the super-long 40-inch linear models. *Nestler* was the only maker who had dividing engines capable of incising linear scale lengths up to 40 inches. So the four 40-inch desktop models *Nestler* made (2 Mannheim's and 2 Rietz's) are all listed in the archive.

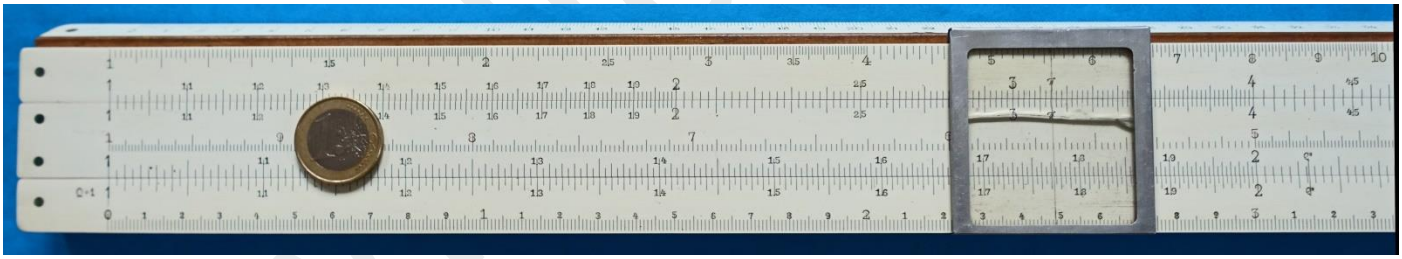

**Figure 4: Nestler 40-inch (100 cm) desktop model 24R/1 with a 1 Euro coin to show the relative size**

Because of their imposing length it is also difficult not to think of demonstration models as long-scale types. However, the vast majority do **not** qualify because of the way they were constructed. Often being made by a local carpenter or a 3rd party, the scales were markedly inaccurate [10, 11]. This serious shortcoming was not a problem because the purpose of any demonstration slide rule was to show to an audience the settings and steps needed to perform example calculations and not to interpolate to 4 significant digits from the back of a training room. The one partial exception was the higher quality demonstration models from F-C. So for the long-scale models where F-C made an accompanying demonstration model, the number of the demonstration model is listed in brackets alongside the reference model's entry.

### *Circular models*

Many examples of circular long-scale models have appeared in the cited publications. However, most of the published circular examples had an innovate design. For example, the helical long-scales of the Otis King models from *Carbic* or the spiral combined long-scale of the model 1010 from *ALRO*. A circular equivalent for the 10-inch linear benchmark was never published. The missing benchmark length was aggravated by the convention to list the "length" of circular models by their diameter. The commonest size of circular model has a diameter of around **5 inches** (12.5 cm). This gives a benchmark circumference scale length of circa **15.5 inches** (39 cm). The original long scale definition still works as long as the benchmark "physical length" is taken as the 15.5 inch circumference for any circular model. All other aspects such as tick mark density, multiple segments, etc apply equally to circular slide rules.

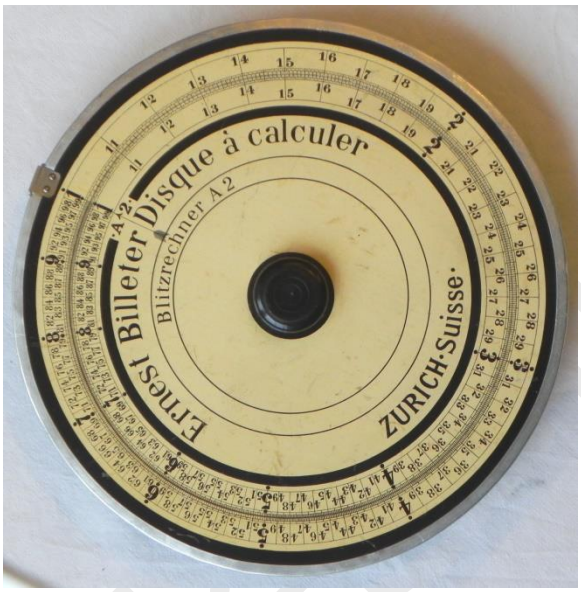


**Figure 5: Billeter Ø 8 inch (21 cm) model A2 Blitzrechner with an effective scale length of 25.5 inches (65 cm)**

### *Drum models*

As with circular models, when it comes to classifying them by size, it is usually not related to the physical length of the drum. Prolific makers like *LOGA* and *National* named and listed their drum sizes by the effective straight-line scale length in metres. However, unlike circular models, the same dilemma for a benchmark length is irrelevant as C and D scales were the "bread-and-butter" of drum models and their construction always meant their effective scale length outstripped their physical length many, many times over. So all drum models are, by definition, long-scale types.

### *World-record models*

These exotic models were included to make the archive complete. Because of their outlandish size they should all be considered long-scale types. However, being a long scale is just one of the many accolades American collector **Jim Bready** should get for constructing his Ø 43 inch (109 cm) circular *Colossus 2* model [12, 13] with its staggering effective looooooooooong-scale length of 10111 inches (25682 cm)!

## Plugging the gaps – the photos

One shortcoming is still stopping the *Long Scale Rules* archive reaching its full potential – too many entries still miss an accompanying image. Over years it has been possible to pick off a few more of the entries lacking an image but for too many there is just a specification [5]. Readers are kindly asked to send any candidate missing photos to Rod Lovett.

## Why my continuing interest?

Specialised cross-maker reference lists are invaluable cataloguing and research tools. However, to compile such a list requires expert knowledge of the chosen area and the untiring focus, usually over many years, by a dedicated collector. Pairing up such compilations with an online search facility means the whole collecting community can benefit from such rich data sources. Initially my interest in the *Long Scale Rules* archive was to ensure lasting leverage of Ed's spreadsheet for the benefit of all. Later I realised that long-scale types of slide rule were also fitting homages to the very essence of why the slide rule was invented – to make multiplication and division quick, easy and precise for the masses!

## Acknowledgements and Bibliography

I am grateful to **Jorge Fabregas** (ZAZAA) for *Figure 2*, **Mike Konshak** (ISRM) for *Figure 3* and **Jacques Perregaux** for *Figure 5*.

[1] **Chamberlain, Edwin J.**: "*Long-Scale Slide Rules*", Journal of the Oughtred Society, Vol. 8 No. 1, Spring 1999, ISSN 1061-6292, Pg. 24-34.
[2] **Chamberlain, Edwin J.**: "*Long-Scale Slide Rules Revisited*", Proceedings 9th International Meeting of Slide Rule Collectors, September 2003, The Netherlands, Pg. 90-117.
[3] **Chamberlain, Edwin J.**: "*Long-Scale Slide Rules Revisited*", Journal of the Oughtred Society, Vol. 13 No. 1, Spring 2004, ISSN 1061-6292, Pg. 23-43.
[4] **Rance, David**: "*A 20/20 Solution That Did Not Help*", Slide Rule Gazette, Issue 20, ISSN 1472-0000, Autumn 2020, Pg. 87-89.
[5] **Lovett, Rodney**: "*Long Scale Rules*", online search facility, 2013, https://osgalleries.org/longscale/index.html .
[6] **Lovett, Rodney**: "*Rod Lovett's Slide Rules*", personal website, https://sliderules.lovett.com/ .
[7] **Fernández, Jose**: "*Long-Scale Slide Rules: From Words to Scales*", Proceedings 24th International Meeting of Slide Rule Collectors, September 2018, United Kingdom, Pg. 15-41.
[8] **Fernández, Jose**: "*Long-Scale Slide Rules: from Words to Scales*", Journal of the Oughtred Society, Vol. 28 No. 1, Spring 2019, ISSN 1061-6292, Pg. 45-63.
[9] **Fernández, Jose**: "*Long-Scale Slide Rules: From Words to Scales – Part 1*", Slide Rule Gazette, Issue 19, ISSN 1472-0000, Autumn 2019, Pg. 94-108.
[10] **Rance, David**: "*Wrong Way Up*", Slide Rule Gazette, Colin Barnes Memorial Issue, ISSN 1472-0000, Autumn 2016, Pg. 50.
[11] **Rance, David**: "*Wrong Way Up: Slide Rules Instruction Aids*", Journal of the Oughtred Society, Vol. 27 No. 1, Spring 2018, ISSN 1061-6292, Pg. 53.
[12] **Bready, Jim**: "*Colossus: the 10,000 Inch Slide Rule*", Journal of the Oughtred Society, Vol. 27 No. 2, Autumn 2018, ISSN 1061-6292, Front cover & Pg. 7-19.
[13] **Bready, Jim**: "*Colossus: the 10,000 Inch Slide Rule*", Slide Rule Gazette, Issue 19, ISSN 1472-0000, Autumn 2019, Pg. 8-20.