

REED Riddle Solved!

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Slide rules from the Southern Hemisphere are mostly unknown, scarce and one in particular, shrouded in mystery.

Geography shapes collections

Before the days of eBay®, there was a distinct correlation between where you lived and the choice of slide rules readily available. On-line auctions, you either love them or you hate them, is changing the collecting topography. But even so, geography still plays a major part in shaping the variety and depth of most private collections. For anyone based in Europe, K&E's and Gilson's are fairly rare and hard to find. In contrast the likes of Fowler, Nestler and Graphoplex are uncommon in the United States. This is why any find from another continent (possibly an undisclosed reason for part of any family holiday plan?) can be particularly appealing and interesting.

Rules from “down under”

I suspect that if most collections were plotted on to a world map, it would show overcrowding in certain areas of the Northern Hemisphere. The fixation that compass north is “up” rather than “down” is attributed to the Greek astronomer Ptolemy (about 85-165 AD). However, whichever orientation is chosen

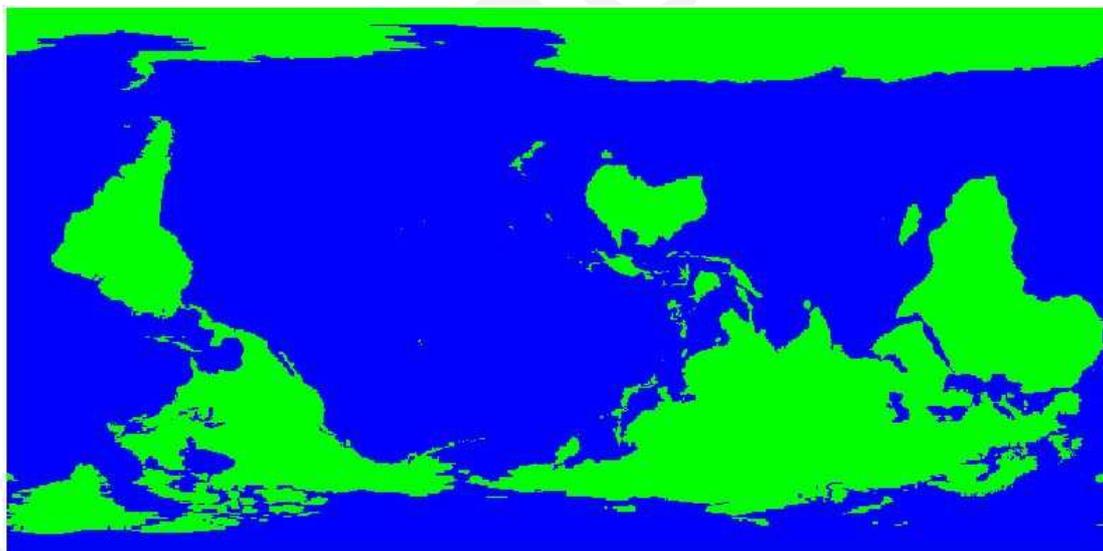


Fig. 1: World as seen by the Southern Hemisphere

slide rules developed and manufactured “down under” are rarely seen in the north and, I suspect, rarely found in most collections. This is partly because even if confined to Oceania, the largest land masses like Australia and New Zealand are considered young nations without, for example, the same rich industrial revolution history as their northern cousins. A full account of the major Southern Hemisphere manufactures falls outside the scope of this article and the knowledge of the author.

But a new appreciation that not everything good has to come from the north came from a recent and now prized addition to my collection – an Australian-made “Electronic Engineers Slide Rule” shrouded in mystery.

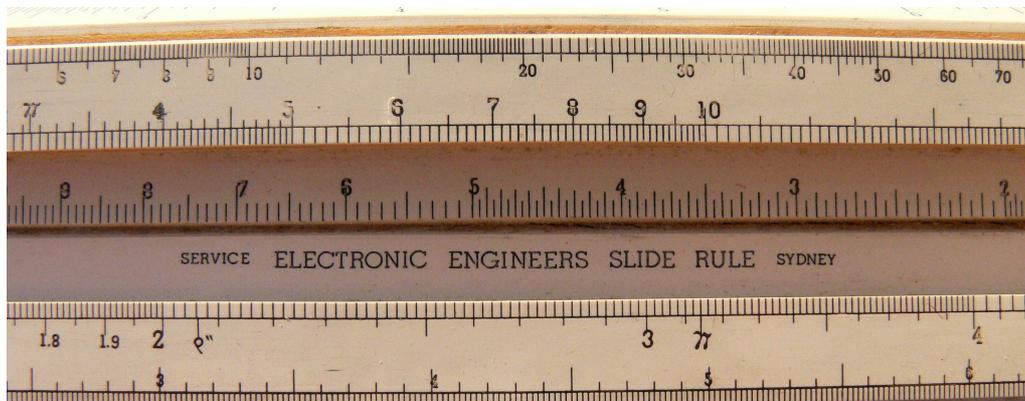


Fig. 2: Mysterious well markings

So why the mystery?

At first glance, the 30cm rule with its bevelled top-edge and use of wooden dowels to anchor the veneers reflects signature qualities of the Stein-based German slide rule manufacturer Faber-Castell (F-C). However, the unambiguous “Sydney” accreditation alongside “Service” in the well of the rule and printed in gold alongside the strange logo on the accompanying black linen covered stiff F-C like cardboard case, confirms its Australian origins.

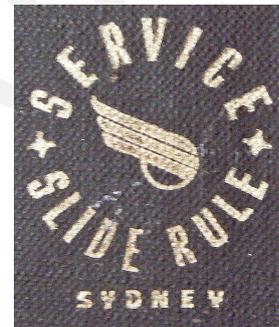


Fig. 3: Mysterious “trademark” logo

The paleness of the wood used for the stock is clearly even lighter than the pear wood often favoured in the past by some European manufactures. But what would be the “natural choice” of wood for a rule manufactured in Australia? Besides, in the well of the rule there was also a weird “*REED model*” citation and a strange looking logarithmic scale. A few manufactures, for example the British maker *John Davis & Son*, choose “eccentric” model names for their rules but most manufacturers denoted special or innovative designs by naming the system after the designer e.g. the rare System Perry, System Schirmer, etc. On this occasion, the normal reference books for more information such as Hopp [1] and Von Jezierski [2] were of little help. Even the powerful Google™ Internet search engine is no help with an all-embracing search argument like “service”!

Prominent Australian – J.G. REED

The first hard evidence and clue came from “*Bright SPARCS*” [3]. This on-line register from The University of Melbourne’s eScholarship Research Centre, lists prominent people involved in the development of science, technology, engineering and medicine in Australia. Alongside the bibliographical data for the distinguished radio engineer, Joseph Griffith REED M.I.E. Aust. (1897-1969), four prominent

publications were listed. One of them was “*Operating instructions: ‘the Reed’ electronic engineers’ slide rule*, Sydney: Service Slide Rule Co.”. Regrettably, like most operating instructions, it is not dated. They were printed by local Sydney printers Winn & Co., which are still in existence today. A price of “One shilling and sixpence” is printed on the front cover but this only narrows it down to before Australia went decimal on February 14th 1966. However, the University of Melbourne contact person for the Reed entry, Prof. Home [4], believes that from checks made when the entry was compiled, the instructions were first published around 1935.

It turns out that radio engineer Joseph “Joe” Reed was a man of many hobbies, adept from early age in handling a slide rule and a leading/pioneering radio technician of his day [5].

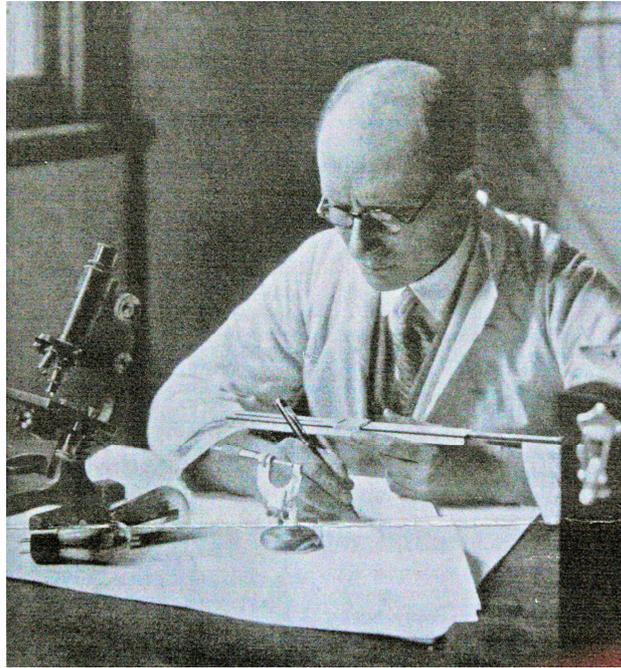


Fig. 4: Joseph Reed at his workbench, probably around 1934

By the 1950’s he had been granted nine work-related patents for his pioneering radio work [6]. One patent, 116600: “*Improvements in radio telegraph transmitters*”, was incorporated in the high-power equipment used by the U.S. Signal service during World War II and later by the New Zealand Post and Telegraph Department. Significantly, I could not find a patent or a registered design for his REED model slide rule but the operating instructions confirmed the existence of a Service Slide Rule Company based in Sydney, New South Wales (NSW).

Service Slide Rule Co. – who?

Had it not been for the foresight of Joseph Reed’s widow, Marjorie, the trail would have immediately gone cold [4]. By the late 1980’s she had moved into a retirement home but she astutely made sure all her late husband’s papers were given for safe keeping to Mitchell Library [7]. Besides Joseph Reed being born in Newcastle, NSW it made sense to donate his papers to the Mitchell Library as they already held the archives of his principal employer, Amalgamated Wireless Australasia Ltd (AWA). Marjorie Reed knew nothing about the manufacturer of her late husband’s slide rule but with the help of the Mitchell Library librarians, I had hoped to discover the full provenance of the Service Slide Rule Company. Disappointingly, unless hidden in some obscure entry in his extensive diaries, no details of the company was found among his papers [8]. What is known is that the company appeared in the Sydney telephone books from 1954 through to 1987. In 1976 the entry was: Service Rule Co. (Stan Bernacki) 45 Stanley St, Peakhurst (a suburb of Sydney). In 1987 it had moved to 58 Barry Avenue, Mortdale (another suburb of Sydney). Despite Bernacki being an unusual name, the probable owner of the company, like the company itself, remains

largely a mystery. He died in the late 1990's and his widow now lives in Brisbane. However, she is, for some reason, reluctant to talk about her late husband's involvement in the Service Slide Rule Company [9].

Service Slide Rules

From the available evidence it appears the company only ever produced two types of solid frame [1] slide rules:

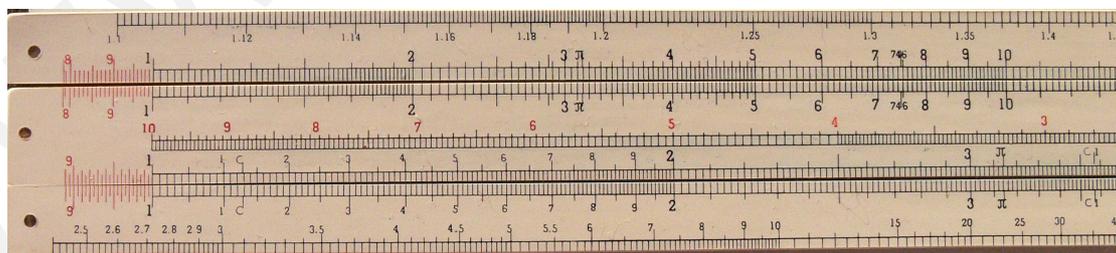
- **type "Electro"**
front: LL1 A = B CI C = D LL3 and back: = S L T =
- **type REED**
front: 10inch / K A = B CI C = D L / 26cm #D/L# and back: = S S&T T =

Given the listing in the Sydney telephone books, the height of manufacture was probably post WW II. However, the Service company apparently persisted with wooden dowels to anchor the sharply etched pale "ivory" celluloid veneers long after their "peer" F-C had stopped using this "old-fashioned" method [10].

Both types were well-made quality rules and going by the ones in my collection, they pass the simple *Soole accuracy test* [11]. However, the hundreds of eucalypt species and climatic diversity of a country the size of Australia makes it difficult to identify the pale yellow finely grained dense wood used for the stocks. It is known [9] that another Australian manufacturer, the Melbourne-based White & Gillespie (W&G), used Australian Silver ash or Quondong wood (n.b. Quondong is the Aborigine word for the *Santalum acuminatum* fruit tree - a wood similar to Indian sandalwood) for their rules. In particular the qualities and characteristics of the Australian silver ash (*Flindersia schottiana*) that was readily available in the NSW region, and W&G's proven use of this wood makes it the probable choice for the Service rules.

1. Service "Electro" rule

This 296 x 31 x 10mm linear slide rule has an all-chrome and glass "type d" [2] single red hairline cursor. As well as the use of wooden dowels, the font used for printing the scales and the π gauge mark make the likeness to certain F-C rules uncanny. The main scales are etched in black. Only the scale extensions, the numbered divisions on the CI scale and the SERVICE RULE Sydney accreditation are in red (variations do exist – e.g. the CI scale all red). Glued on the back (variations are known to exist) of the rule is a plasticised paper table of conversion factors and simple formulas.



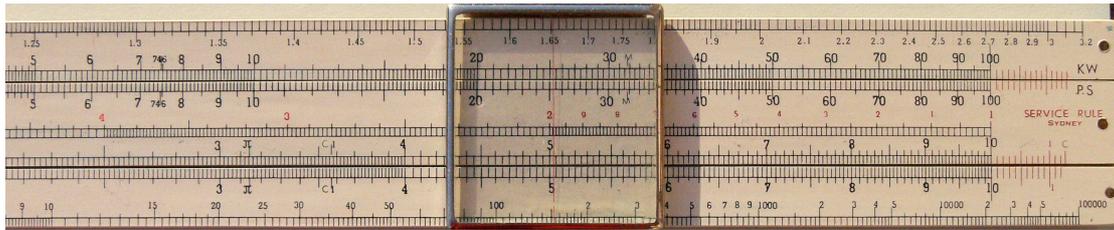


Fig. 5: Type “Electro”

As LL scales, “KW” (*kilowatt*) and “PS” (metric horsepower from the German *Pferdestärke*) scale annotations and many gauge marks have been added to a basic Rietz layout, this model meets the Bob Adams criteria for an electro rule [12]. However, one of the scale annotations is suspiciously “wrong” and is yet more evidence that the Service company may have too literally “plagiarised” features from other rules. As an electro rule for the home Australian market, it makes sense that the company included the gauge mark value 746 [13] on both the A and the B scales. This is the imperial value for motor efficiency in kilowatts but then the scale annotation at the right-hand end of the B scale should have been “HP” (British horsepower) and not “PS”!

2. Service REED Electronic Engineers rule

This is a larger, 298 x 42 x 13mm, linear slide rule but with the same style all-chrome and glass “type d” single red hairline cursor. A special 3-line cursor, as a short-cut aid to calculating the area of circles, could be ordered as an optional extra. A similar font is used for the scales but this time the style of π gauge mark is different to F-C. The main scales are mainly etched in black. Reed calibrated the K, L, S, S&T and T scales relative to the D scale. In contrast to the “electro” type, the CI scale is extended and entirely in red. The company name and the “REED Model” accreditation are printed in black in the well of the rule alongside an unrecognisable logarithmic scale. Glued on to the back of the rule is a “Made in Australia” paper table of various formulas and conversion factors.

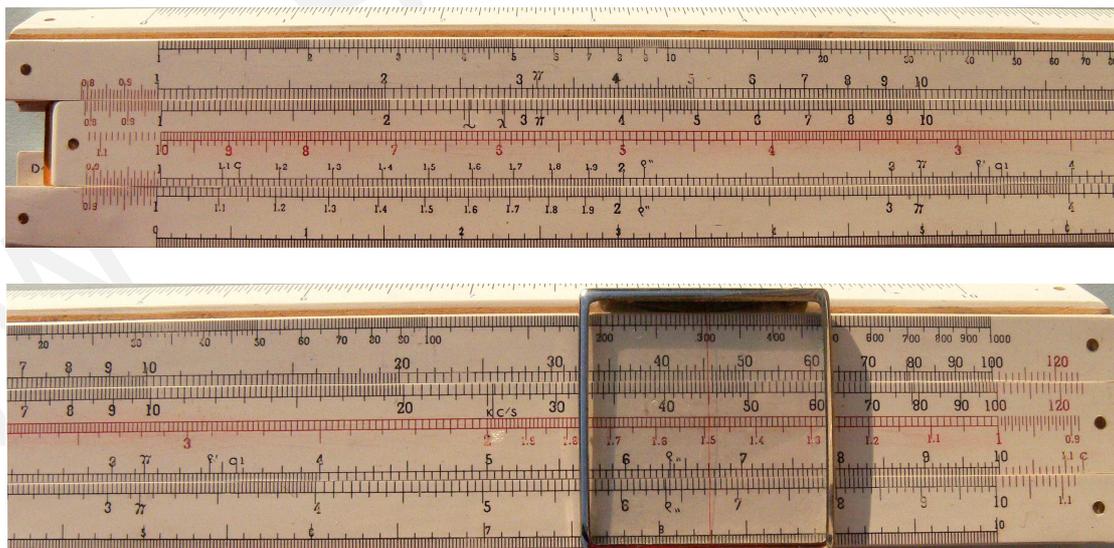


Fig. 6: Type REED

Unlike electro rules, electronic rules need, for example, to calculate the impedance of circuit elements in the higher 0.1 to 100 Megahertz (Mhz) range of frequencies [12]. With Reed's choice of scales and their layout it can easily do this and largely meets the respected Eugene Charles Alvarez's definition of a slide rule for electronic technology [14]. However, Alvarez also felt that rules for electronic technology needed to be of a deci-trig type. The Reed design only has standard trig scales giving angles in degrees and fractions of degrees. But Reed compensated for this "omission" by adding, arguably more convenient, a set of gauge marks for calculating in radians. In fact Reed had a seriously ambitious objective for his rule. In the operating instructions he states: "... has been designed to provide a group of scales within one instrument, meeting the requirements of the ever growing army of workers engaged in the various branches of Electronic Engineering."

It has a distinctive British "Simplon Electro Log-Log" look-alike wooden chisel-shaped "lawn edger" on the left-hand edge of the tongue to read off the mysterious split (25-0) "D/L" scale cleverly placed in the well of the rule

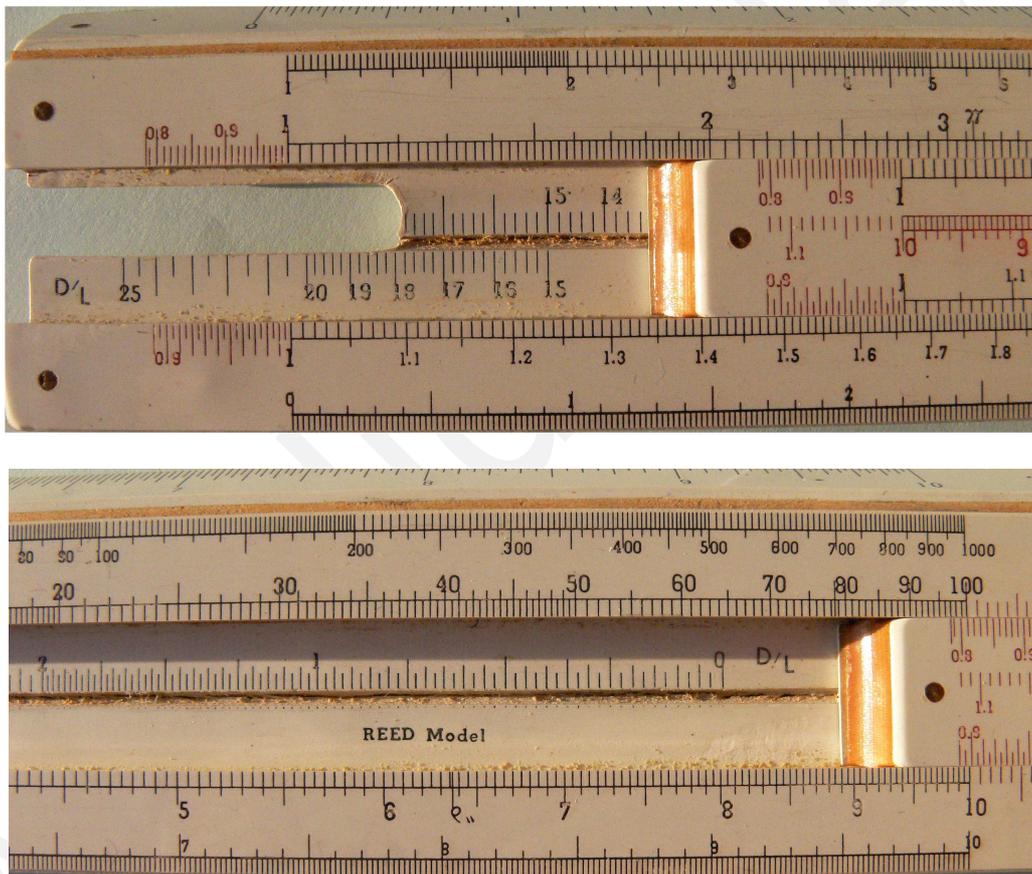


Fig. 7: Mysterious D/L scale

It turns out the scale is more commonly known as *Nagaoka's coefficient* [15] after its originator, the Japanese physicist Hantaro Nagaoka (1865–1950). Communication engineers often need to calculate the inductance of electrical windings – e.g. a solenoid of a certain length, a certain diameter and a number of windings. This previously unheard of "Diameter to Length" (0 being the infinite length) logarithmic D/L coefficient scale is a masterly Reed innovation for reading off the Nagaoka factor "K" in the inductance formula $\frac{(\pi \times d \times n)^2}{1000 \times b} \times K$ in Microhenries - where d = the diameter

in centimetres, b = the length in centimetres and n = the total number of turns. Without including the K factor there is a serious error due to magnetic non-uniformity when the coil is short and its length is comparable to its width. This was, for example, frequently the case in coils for the valve radio industry.

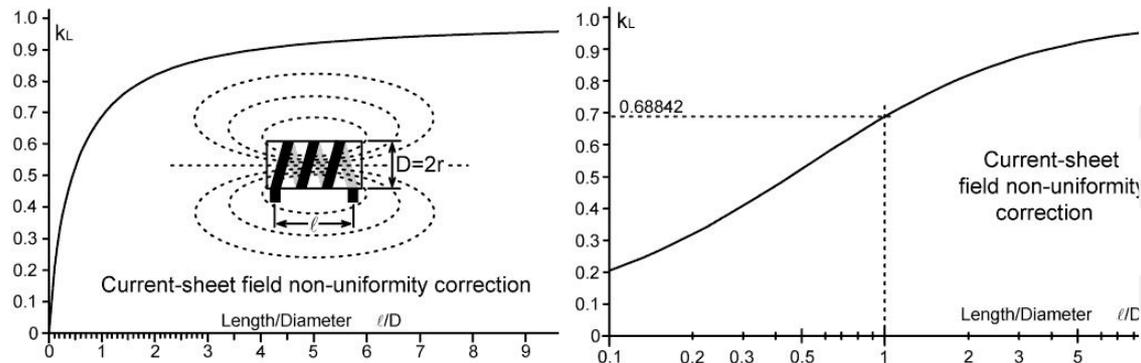


Fig. 8: Diagrams showing the non-uniformity corrections needed [15]

Danish physicist Ludwig Lorenz (1829-1891) devised in 1879 the analytical expression need for the inductance of a coil of any length. But it was Nagaoka who took Lorenz's work and in 1909 turned it into a practical correction factor or coefficient but the procedure to calculate it was complicated. With Reed's innovation the "lawn edger" is used to set the value of the $\frac{d}{b}$ ratio on the "D/L" scale and the K

factor can be directly read off the D scale using either the left or right-hand index. Reed's innovative "D/L" scale is surprisingly "missing" from all other electronic slide rules, including such well-regarded classics such as the "Pickett N-515-T" or the "Sun Hemmi 266".

Reed included a first set of three innovative gauge marks on the B scale. The Tilde symbol "~" (also used in electronics to represent alternating current) is set at 254 and is used when calculating resonant frequency in cycles per second of circuits with constants expressed in either Henries (for inductance) or Microfarads (for capacitance). The next, the Greek lower-case Lambda " λ " mark, is set at 282 for calculating the wavelength of the frequency (i.e. the distance light travels in the time taken by one cycle) in metres of resonant circuits with constants expressed in Microhenries and milli-Microfarads. The last gauge mark denoted by "KC/S", is set at 254 and is an alternative to the "~" gauge mark for expressing the circuit in Kilocycles per second. Reed included a second set of gauge marks (also found on other rules) on the C scale. A "C" mark set at $1128 \left(\sqrt{\frac{4}{\pi}} \right)$ and another, "C1", set at

$3568 \left(\sqrt{\frac{40}{\pi}} \right)$ act as alternatives to the optional 3-line cursor for respectively

determining areas of circles and the volume of cylinders. Reed included a final set of three gauge marks (only found on some electro/electronic rules) on the C and D scales. They are all variations of the Greek lower-case Rho and are perhaps not unsurprisingly similar in style to the same marks on the "Simplon Electro Log-Log" rule. The first, " ρ " is set at $2063 \left(\frac{180 \times 60 \times 60}{\pi} \right)$. The second (only on the C scale), " ρ ", is set at $3438 \left(\frac{180 \times 60}{\pi} \right)$. The final gauge mark, " ρ ", is set at $6366 \left(\frac{200 \times 100 \times 100}{\pi} \right)$. All three gauge points provide values in radians for sine and tangent functions.

Riddle solved – “System REED”

Good riddles are often frustrating and hard to crack. So perhaps it is fitting that in this case, some aspects of the riddle remain unsolved. Clearly the Service Slide Rule Company of NSW deserves to be listed alongside the more well-known Australian manufacturers such as W&G and CAL.

The likeness of the Service slide rules to the certain types from F-C and Simplon is too great to be a coincidence. It is known that F-C had a strong market position in Australia but equally they never co-operated with a local manufacturer [10]. So some degree of “borrowing” from slide rules already being sold in Australia at the time may well have been part of the tooling process used by the Service Slide Rule Company. It may also be the reason why specifics about the company and its logo remain sketchy. Perhaps the scarcity of rules from the Service Slide Rule Company is also why they are so often miss-catalogued? I have seen both types attributed to either Service, Sydney or Reed but never listed together.

Despite the dubious similarities to certain design aspects of other manufacturers, the Service Slide Rule Company deserves to be recognised as a maker of particularly fine slide rules. Like most manufactures, the company offered an “electro” rule but more striking is the innovative design of the “System REED”. With its unique Nagaoka’s coefficient scale and many useful gauge marks it was truly a speciality slide rule for electronic engineers and would seriously grace any slide rule collection.

Finally, the history of the slide rule seems peppered with interesting innovators. Australian Joseph G. Reed (1897-1969) would deserve an entry in any “hall of fame” of such characters.

Acknowledgements

Many people helped me find the clues I needed to solve this riddle. Also as my electric/electronic knowledge does not extend much past fitting a plug to a household electrical device, I needed help. Most of you know who you are, but I would particularly like to thank (in alphabetical order):

- **Bob Adams** for help with everything electrical/electronic related,
- **Cyril Catt** (with Bob Adams) for some local “down under” sleuth work,
- **Wendy Holz** for trawling through the Reed papers at the Mitchell Library and for copies of all relevant documents,
- **Rod Home** for the initial leads on Joseph Reed and a copy of the 20-page operating instructions for “*The Reed Electronic Engineers’ Slide Rule*”,
- **Dieter von Jezierski** for lots of helpful F-C related information,
- **David Knight** for permission to reproduce the non-uniformity diagrams from his website.

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