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Browne Fuller-Type Cylindrical Slide Rules

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Browne cylindrical slide rules are relatively rare, poorly documented, and are the only examples of Fuller type, long-scale, cylindrical slide rules known to have been manufactured in Australia. They were made in the 1960s by C. O. Browne, owner of a small engineering business in Melbourne. Two models were produced, F.C. 46 and F.C. 221 (Figures 1 and 2), both derived from the "Fuller Calculator" which was designed and patented in 1878 by Prof. George Fuller of Queens College, Belfast. Their Fuller origins were acknowledged by Browne because Model F.C.221 has "Fuller Calculator" printed on it as part of the model inscription and the handbook for Model F.C.46 is titled "The Fuller Calculator F.C. 46".

Figure 1. Boxed Browne Cylindrical Slide Rules: Model F.C.46 (left) and Model F.C.221 (right)

Browne's Slide Rules

Browne's cylindrical slide rules were made in two sizes that share the same diameters of tubes and the same materials in their construction. As can be seen from Figure 2, the larger model, F.C.46, was smaller than a Fuller rule and consequently had a shorter helical scale, although this was more finely divided.

A brochure for Model F.C.46 states that "The calculator core

is made of special paper impregnated with Bakelite and resin (waterproof). The scales and tables of meticulous accuracy lithographed on finest quality art paper, coated with a heavy layer of protective plastic film. The ends are black Bakelite mouldings, and the pointers are of aluminium". Both models were supplied in wooden boxes, as shown in Figure 1 and the larger version has a bakelite handle at one end and can be mounted on its box at an angle, via a bracket which clips onto the box and fits into the handle, to leave both hands free to operate the rule, a feature shared with Fuller's original rules.

Figure 3. F.C.221 Browne Assembled and with Separated Components

slides over the telescopic body, where it can be moved lengthwise and rotated. The three tubes are kept in set positions relative to one another by friction. The outer logarithmic scale tube has a cloth inner lining to avoid wear of the "Conversions and Useful Data" printed on the underlying tube, which include shillings and pence as decimal fractions of a pound, fractions of inches as decimals, and some imperial and metric unit conversion factors.

Since a Fuller-type slide rule has only one logarithmic scale, a single multiplication/division requires an initial setting of the scale to measure the length corresponding to the logarithm of the first number, then a second movement to add/subtract the length corresponding to the second number. These two movements are recorded by the aluminium pointers on the telescopic body, a double pointer with the two indices spaced apart by the axial length of the helical logarithmic scale on the scale tube, and single aluminium pointer on the outer tube.
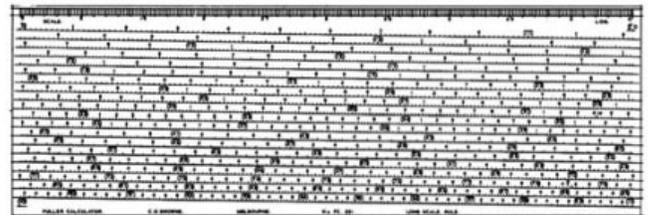

Figure 4. The Helical Logarithmic Scale of a Browne F.C.221 Slide Rule, taken from an Unused Paper Scale

Figure 2. Fuller, Browne FC46 & FC 221

Model F.C.221 uses a twenty turn helical logarithmic scale for calculations, of approximately 165 inches (4.19 metres) total length, divided into 1000ths at the beginning of the scale and 200ths at the end of the scale, resulting in 320 divisions. The layout of an unmounted scale is shown in Figure 4.

In Figure 3 the two tubes shown centre left and centre right are fitted with moulded plastic ends and aluminium index pointers and assemble to form a telescopic body, with the centre left tube fitting inside the centre right tube. The third tube, shown on the right, carries the logarithmic scale and

Model F.C.46 rules (Figures 1, left, and 2, centre) have fifty turn helical logarithmic scales of 413 inches (10.490 metres) total length, divided into 2000ths at the beginning of the scale and 1000ths at the end of the scale. The wording on this scale is shown in Figure 5. For comparison, original Fuller rules also have a 50 turn scale but on a larger diameter cylinder, giving a longer scale length of 500 inches (12.70 metres), but with only half the marked divisions of the Browne F.C.46 version (i.e. 1000ths at the start of the scale and 500ths at the end of the scale). Compared with the F.C.221, the longer telescopic section of the F.C.46, required to accommodate its longer logarithmic scale, provides space
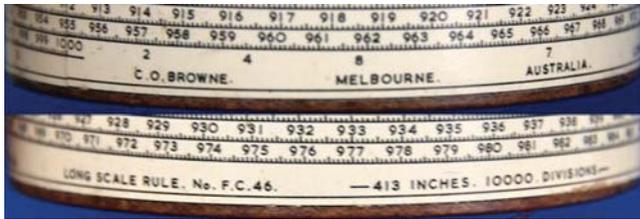
for additional "Useful Data".

Figure 5. The Inscription below the Logarithmic Scale on a Browne F.C.46 Slide Rule

The Maker, C. O. Browne

Information about the designer and maker, Collis Oliver Browne (1917 – 1988), has mostly come from discussions in 2011 with his widow, Betty Browne, and with the youngest of his five children, Andrew Browne, and his brother Philip. The family possesses boxed examples of his slide rules, instruction leaflets, some spare parts including unused printed scales, an experimental scale printed on thin metal sheet (Figure 6), a small, boxed, all-metal version of a cylindrical slide rule (Figure 7), several prototypes (Figure 9), and a photographic negative of the F.C. 46 logarithmic scale.

Collis Browne ran his own general engineering and tool making business at 186 Through Road, Burwood, Victoria, the address on the slide rule instruction leaflets. The business was small, with never more than three employees, including at one stage his two sons, who undertook turning and fitting apprenticeships with their father. His customers were mostly metal and plastics manufacturers, and the business made pressed metal tooling, moulding dies and other manufacturing equipment, and carried out installation and repairs of manufacturing machinery. The business later moved to 18 Sixth Avenue, Burwood, and ceased operations in 1976, because of illness of the owner.

Collis Browne was a man of many interests. He was an enthusiastic photographer. He made, including grinding the lenses, a motorised telescope for astronomical observations, several microscopes, and a wide-angle camera lens. In the 1970s he studied electronics at a Swinburne Technical College, built his own radio receivers, undertook repairs of TV sets, and wrote his own programs for an early Tandy computer.

Slide rule manufacturing was an adjunct to the main engineering business. The family remembers Collis setting out and drafting large scale versions of the scales for his slide rules on paper on a drawing board at the kitchen table, which was also used for some of the assembly of the final product. Judging from a dimension line still showing on the edge of a photographic negative for an F.C.46 logarithmic scale, with a notation that it was to be reduced to 8 and 5/16 inches, the log scales for his rules were drawn at large sizes for accuracy, then photo-reduced for printing. The tools for pressing

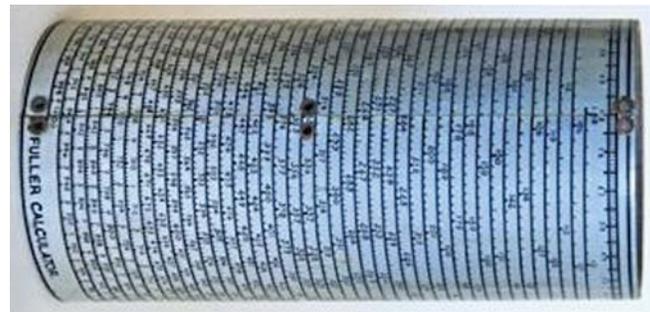the aluminium cursors were made in the engineering works, as were the dies for the bakelite ends and handle.

Figure 6. Prototype Scale Printed on Thin Metal Sheet

Figure 7. Small Metal One-off Cylindrical Slide Rule

Figure 8. A 1963 Dobbie Bros. Catalogue Page

Slide Rule Sales

Browne family memories are that total slide rule sales were only a few hundred, all in the 1960s, and that most sales were of Model F.C.46. Receipts in the possession of the family, dated in the early 1960s, show that the rules were initially sold directly to a few businesses by the maker, singly or in small numbers. A brochure bearing Browne's name, presumed to be from the early 1960s, gives the price of an F.C.46 as Australian £15/17/6, plus 12.5% sales tax. In 1961 this was a considerable amount of money, equivalent to about Australian $390 plus tax in 2010 values (using an Australian Reserve Bank inflation calculator). This was claimed to be "approximately only two thirds of imported calculators of a similar type, besides being of greater capacity." The "greater capacity" claim presumably referred to the finer scale divisions of the Browne rule compared to the Fuller rule.

By February 1963, Dobbie Bros., a Melbourne retailer of scientific instruments and equipment, had become the "sole Australian agents", as indicated by a page for Model F.C. 46 in the firm's 1963 catalogue (Figure 8). The list price had dropped substantially to £11/17/6.

Acknowledgements

References

1. John Wolff's Web Museum (slide rules, mechanical calculators, mechanical music): http://home.vicnet.net.au/wolff

2. Hopp, Peter M. *Slide Rules: Their History, Models, and Makers,* Astragal Press, 1999

3. Bolton, B. and Williams, N.: *Calculating Before the Chip, an Australian Perspective*, Australian and New Zealand Physicist, Volume 33, Number 6, July 1996.

Figure 9. Two Early Prototypes and an F.C.46