Elmer A. Sperry and His Calculator

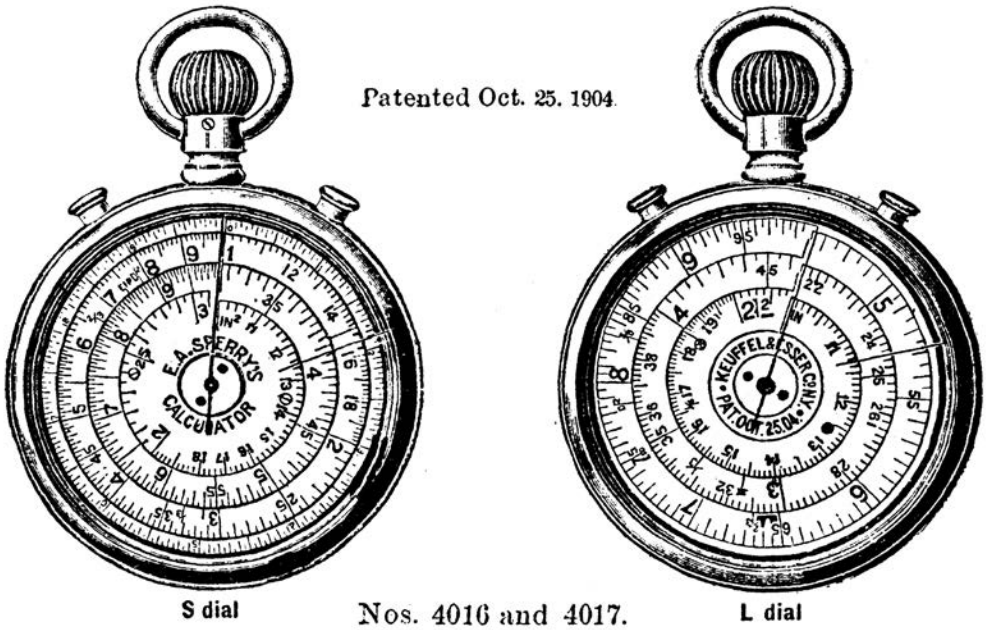

Figure 1. The Early Sperry Calculator from the 1906 K&E Catalog

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Introduction

The purpose of this article is to discuss Sperry and Sperry-like pocket calculators. These are circular slide rules with the shape and size of a pocket watch. In the sense of this article, the term includes the Boucher Calculator, the Sperry Calculator and the K&E Calculator. It does not include related pocket calculators, such as either the British ones made by Fowler and Halden, or the German (?) version marketed Schact & Westrich [2]., or the Charpentier [6,7].

A Short Summary of Elmer Sperry

The reader interested in Sperry the person and inventor should read the excellent book by Hughes [4]. Suffice to say that Sperry was one of the major figures in invention and engineering in the late 19th and early 20th century.

Elmer Ambrose Sperry was born October 21, 1860 in the home of his mother's family at Cincinnatus, NY. He was the son of Stephen and Mary (ne Burst) Sperry. His mother died immediately after his birth.

The family home was in Cortland, NY, and Sperry spent much of his early life near there. One of his first interests was lighting through the use of arclamps. He applied for a patent in 1880 for a dynamo-electric machine. This was the first of over 350 patents that he received.

His range of invention was varied: the gyroscopic compass, the gyroscopic stabilizer for ships, and a myriad of diverse and important devices. Perhaps one of the most obscure of these is the topic of this article: US Patent 750,500 [8], submitted December 21, 1903 and granted October 24, 1904 for a "Logarithmic Calculator." Mr. Sperry died June 16, 1930.

The Boucher Calculator

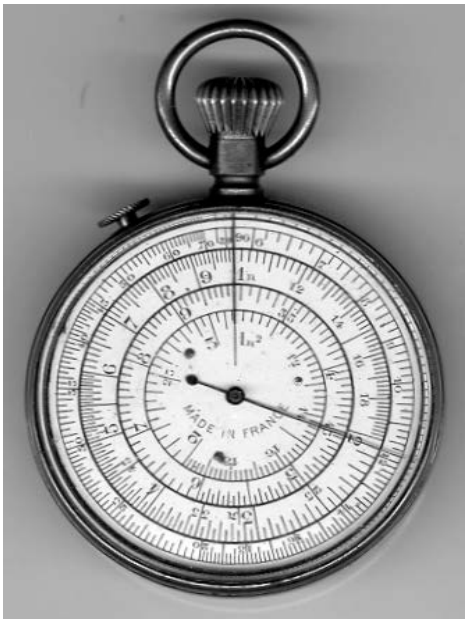

Figure 2. A Boucher Style Calculator

Before taking up the Sperry Calculator, it is worthwhile looking at the calculator invented by A.E.M. Boucher, the predecessor and competitor to the Sperry.

The Boucher Calculator is similar to the Sperry. In truth, I do not know very much about the history of this calculator (it should make an interesting article). What was available to me at the time of writing is the British Patent [3]. The calculator shown in the above figure says on the reverse *CALCULIGRAPHE H.C. PARIS.* The assumption is that this one was made after the Boucher patent ran out.

In any event, the H.C. seems to work in the same manner as the Boucher. A description of the operation follows:

- The basic idea goes back to Oughtred: a circular logarithmic scale with two arms pinned at the center which act in combination as a pair of dividers. In this case, one arm or *pointer* of the dividers is fixed. It is attached to the case, passing close to the scale. The second pointer turns on the center spindle and is movable. It travels over the fixed pointer.
- The device is operated through the use of the top "winding" knob, and the push button shown over to the left.
- The knob, with the push button up, turns the whole dial in either direction. While this is being done, the three pointers remain fixed (the third pointer is on reverse side of the calculator).
- When the push button is pressed, it disconnects the knob from the dial, and connects it to the movable pointers on the front and back. So, one can turn either the pointers or the dial, but not both at the same time.
- There are four scales shown on the face: the outer is trigonometrical; the second one in is the logarithmic scale, and the inner two in combination are used for operations involving squares and square roots.
- On the back of the instrument, there is a fixed scale and a moveable pointer. The pointer also turns on a center spindle, apparently directly connected the pointer on the front. The scales on the back consist of a linear scale for computing the logarithm of a number, and a three part cube and cube root scale. Unless I am missing something, these scales are clumsy to use. For example, to find the cube root of 64, one would set the fixed pointer on the front to one, turn the moveable pointer to 64, and then read the value 4 as indicated by the pointer on the middle of the three parts of the cube scale on the back.

The operation of this Boucher is as follows: suppose we wish to multiply two times three using the log scale. We would:

1. Use the knob to turn the dial until "one" on the log scale falls directly under the fixed pointer.
2. Push the button and turn the knob until the movable pointer rests one "two."
3. Release the push button and then turn the knob until the "three" on the knob falls under the fixed pointer.
4. Read the answer "six" under the movable pointer.

Somewhat on the slow side, but there are some advantages. Accuracy is discussed below.

Summary of the Sperry Calculator Models

The Sperry calculators of all kinds fall into the following groups:

- **I – Patent Model** This is described in the Sperry patent of 1904 [8]. Many features of the patent do not appear to have been implemented in the marketed version, model **II.** The patent device looks to have been worked by a single knob, which both turned and shifted positions by moving in and out. The shift of position of the knob, ie., moving it in or out, permitted the user to switch from turning the dials to turning the pointers. This mechanism looks complicated, and probably never was built as specified in the patent. The scales, however, are the ones that are used in all Sperry Calculators.

- **IIa – Early Model, 4016** This version is shown in the 1906 catalog only. It is worked by a knob and two push buttons, and the dials turn at different speeds, apparently in a three to one ratio. This and the model IIb are shown in Figure 1, taken from the 1906 K&E catalog [5]. An instruction book exists for both versions [1].

- **IIb – Early Model, 4017** This version is also only shown in the 1906 catalog. Like the 4016, it has two push buttons to operate it. It differs from the 4016 in that the two dials turn at the same speed.

The Models IIa and IIb are the only ones to have the push button mechanism, and they only appeared in the 1906 catalog. It would seem that the original mechanism in the patent was too complicated to produce, so that something akin to that of the Boucher Calculator was employed. Who designed this mechanism is not known: two possible candidates are Sperry himself and Lange (see below). One example of the type II is shown on page 291 of [4]: it is Sperry's personal calculator; Hughes notes that "Sperry always carried a circular slide rule (of his own design)..." These models are very rare.

- **IIIa – Later Model, 4017** This model first appears in the 1909 catalog [6]. It does not have the two push buttons. Rather it is operated by a thumb nut and a knob (top) which are on concentric axes, the milled nut turning the dials, and the knob turning the pointers. It has the Oct. 25, 1904 patent date on it, but has the Lange mechanism.

Figure 3. A model IIIa showing the L dial.

Figure 4. A K&E model IVa. Courtesy of R. Shepherd.

George Lange [7] patented the calculator mechanism that is to be found in almost all of the known examples of the Sperry. The application for the patent was filed in 1908, but was not granted until 1911. Hence, some examples will have the Sperry 1904 patent date, some say "patent applied for," and later ones give the Lange 1911 patent date.

Lange states in the patent (which is assigned to K&E): "My invention relates to calculating devices involving logarithmic notations in the general nature of a slide rule and specifically is an improvement upon a device of that character which forms the subject matter of Letters Patent of the United States No. 773,235, issued Oct. 25th, 1904 to Elmer A. Sperry. Experience with the manufacure and use of the device, which forms the subject matter of that patent, has demonstrated that it is somewhat costly to make, and at times difficult to use in practice. The latter feature especially arises on account of the numerous spur and bevel gears which form part of the actuating mechanism. The back lash which arises is considerable and is apt to cause a sluggishness in the relative movements of the dials, the pointers and indicators which must be allowed for by the operator or an inaccurate result will occur."

- **IIIb – Later Model, 4017** Apparently identical to the IIIa, the difference being that the patent date is Dec. 26, 1911. That is, the date of the Lange patent.

- **IVa – K&E Version, 4018** This calculator first appears in the 1909 catalog, and looks very similar to the 4017. It differs in not having the L dial and not having *E. A. Sperry Calculator* on the S dial, nor the Oct. 25, 1904 patent date. Rather, it says patent applied for, no doubt referring to the Lange patent.

- **IVb – Later Model of the 4018** This has the Dec. 26, 1911 date of the Lange patent.

Catalog Listings

Ed.	Year	Page	Models	Prices	Type
32nd	1906	316	4016	20.00	IIa
			4017	18.00	IIb
33rd	1909	306	4017	15.00	IIIa
		307	4018	13.50	IVa
34th	1913	296	4017	15.00	IIIb
		297	4018	13.50	IVb
35th	1915	296	4017	15.00	IIIb
	1915	297	4018	13.50	IVb
36th	1921	233	4017	22.50	IIIb
		234	4018	20.25	IVb
37th	1927	314	4017	27.50	IIIb
			4018		Gone
Supp.	1934	26	4017	27.50	IIIb
38th	1936	310	4017	27.50	IIIb
39th	1943				Gone

Accuracy of the L Scale

The chief advantage of the Sperry over the Boucher appears to be the L scale. As seen in Figures 1 and 3, it is in three segments, but is not quite a three turn spiral, nor is it exactly three concentric circles, but rather falls somewhere in between.

A rough estimate was made of the length of the L scale. As near as I could tell, it totals about 12.1 inches (or, about 31 cm) in length, thus being slightly longer than the standard 10 inch (25 cm) C scale on a typical slide rule. Also, I counted (equivalently) 321 marks on the scale, the exact same number as those on the average 10 inch slide rule C scale. In comparison, the Boucher style calculator has 171 marks on its single scale. The spacing on the Sperry rule would have permitted more

marks on the range four to six. It is curious that this was not done.

In its favor, the L scale is on metal, and probably will not deform. There is no second scale which could potentially change at a different rate, and hence cause reading problems.

There are two things that detract from its accuracy:

- An examination of the marks indicating numbers on the scale will show that they are rather wide compared to those found on regular rules. They appear to be on the order of 0.005 inches in width, as compared to .004 inches for a K&E rule made by Dennert & Pape, or perhaps 0.002 inches wide for a boxwood Mannheim rule made by Tavernier–Gravet. This may tend to make it more difficult to interpolate to a third digit.

- The fixed reference indicator is scribed on the underside of the glass cover of the calculator. As there has to be enough space between the dial and the glass to accomodate the movable pointer, this space can result in parallax errors if the calculator is not held exactly perpendicular to the user. Parallax error generally is a problem with most of the pocket watch variety of slide rule.

Still, it will work about as well as a pair of 10" C and D scales on a standard Mannheim rule.

When the fixed points on the glass on each side of the rule are properly aligned, the rule will do the calculations done by the Boucher such as taking the cube root in a much more efficient manner. This is due to the fact that both dials turn (recall that only one dial turns on the Boucher). The Sperry, however, does not have the sine scale to be found on the Boucher example shown.

Serial Numbers?

Some of the examples are numbered. The model IIIa shown in Figure 3 has the number 353 stamped on the edge near the attachment loop. Some do not have these numbers. Not enough information on surviving Sperry Calculators has been collected that would warrant conclusions on what these numbers might mean.

Concluding Remarks

Did K&E actually make these rules rather than outsourcing them? Were they instead made by some New England watch company? If so, which one? How many were made of each kind? Was this a successful product?

I do not know the answers to the above questions. Guessing:

- I believe that not many were made, perhaps on the order of 2000-4000.

- The product was not particularly successful. The Sperry was expensive. K&E [5] would sell you a 10" Mannheim rule for $4.50. The Boucher could be had for as little as $7.00 [5] (an elaborate version was $19.00). The original price was $18.00 for the 4017 and $20.00 for the 4016, making this a prestige item.

A significant problem is that there are so many versions: there are six different ones if the K&E calculator is included. Note: some people owning the K&E (only) type think that they have a Sperry: it has to have the L scale and say "E.A. Sperry's Calculator" to be a Sperry. The IVa and IVb are not Sperry's, but rather something like "K&E in the style of Sperry." Does this really make a difference? A reasonable answer is no, except when one is advertised for sale, in which case it should be made clear exactly which version is being offered.

References

1. Anonymous, *Directions for Sperry's Calculator,* copyright 1906 by Keuffel & Esser Co. This booklet does not list a model number, nor does it refer to the different dial speeds. Hence it could be given out with either the 4016 or the 4017 model.

2. Bennett, A., *Schact & Westrich Calculator,* JOS Vol. 4, No. 1, March, 1995.

3. Boucher, A.E.M. English Patent number 4310 granted November 7, 1876. Actually, the patent was granted in the name of H.E. Newton, but mentions Boucher's name as the inventor.

4. Hughes, Thomas Parke, *Elmer Sperry Inventor and Engineer,* The John Hopkins University Press, 1971, Softshell Books edition 1993. ISBN 0-8018-4756-7 (pbk).

5. Keuffel & Esser, *Catalogue of Keuffel & Esser,* New York, 1906, 32nd edition.

6. Keuffel & Esser, *Catalogue of Keuffel & Esser,* New York, 1909, 33rd edition.

7. Lange, George, US Patent 1,012,660, filed June 24, 1908 and granted Dec. 26, 1911.

8. Sperry, Elmer, US Patent 773,235, filed Dec. 21, 1903 and granted Oct. 25, 1904. This patent has 45 claims.