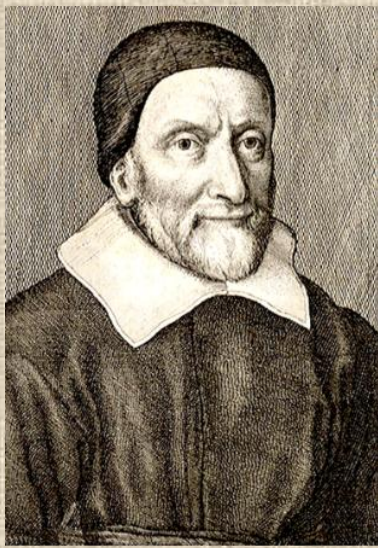


Oughtred and Delamain Inventions



William Oughtred

+

William Forster



Richard Delamain

Elias Allen



Jose G. Fernández

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Delamain and Oughtred inventions

Data from Groups.io, by Jose G. Fernández

1 Introduction

More than 60 pages of text, in about 125 messages show that the years after Edmund Gunter invented his Rule have been of great interest to the slide rule collectors' community. In this article I will try to compile the facts in these threads. I have also contacted the main participants, Andreas Poschinger and Tom Wetmore, and they have agreed to share the original documents they have been using.

I am not going to deal with Oughtred, Delamain and others' opinions, as we know these were biased. Only say that both Oughtred and Delamain were well known persons in those times, with good reputations.

When two people communicate, there is a part of the data shared that is lost and the gaps are filled with each listener's own data. After some hundreds of patents dealt with in my professional life, I can confirm that an engineer's initial statement after reading a patent is "it is common knowhow" or "we already use this" or "we used this in the past in many products". Add to this the heat of the collision of interests and you get the writings obscuring the facts in those years.

Also, I will try to avoid giving opinions (what you think or believe about something) but come to conclusions (when you decide on something after having considered all the relevant facts).

Finally, the title of the article talks about inventions, and we are in 2026. Then, I will use what an invention is in today's patent domain as it is the most detailed definition of it. First, it is something new, it did not exist before, but also an expert in the field could not easily get to it. Finally, there is the reduction to practice, that is, the invention must be something manufacturable, not an idea or a concept or a prototype not yet developed in a device.

Said this, our initial starting point is in 1624, when Edmund Gunter drew a line with logarithms of numbers in an existing ruler for navigation, with the respective scales of sines and tangents. The Gunter rule (or ruler) had been invented. Gunter had published tables of logarithms (after Napier and Briggs) and converted them into graphical lines. He kept the use of a pair of dividers (a compass) for the calculations, as it was what was used with the other scales of the navigation ruler.

2 What a slide rule is

This is also a key for this article, as not always the reader may have the same point of view. The most generic understanding of what a slide rule is that I could gather is:

A device enabling multiplication and division calculations based on at least a logarithmic scale drawn on the device.

From this definition we understand that the device does not need other elements to perform such calculations.

Then, I have tried to define a logarithmic scale as the graphical representation of $y = \log_a(x)$ (no needing to be Cartesian axis), using n decades in a line or several segments of it.

Alternatively, it may be a linear device (a rule or ruler), circular (disc), cylindrical, etc. Also, it may have a cursor (single, double) to facilitate setting and reading numbers (even with magnifier). And any material capable of making an usable device may do (paper, cardboard, wood, plastic, metal...).

Nevertheless, in XX century, the slide rule term was so common that other devices (with nomograms...) for complex or specific functions were also considered slide rules (the difference with slide charts subtle).

3 Chronology of Publications

What we can use to make conclusions is the data available, and so the publications together with the already existing devices are our basis. However, the publication dates are not yet clear and, so, I will only include those publications relevant for this article, and will use the references in them to set the publication order:

Reference	Author	Title	Details
1	Delamain	Grammelogia or the Mathematical Ring (first version)	Basic description of the invention Patent rights included
2	Oughtred	The Circles of Proportion and the Horizontal Instrument (translated from Latin into English by William Forster)	It is written to show Oughtred "precedence" to document 1
3	Delamain	Grammelogia or the Mathematical Ring (second version)	Answers Foster (Oughtred) comments in document 2
4	Oughtred	The just Apology of Wil. Oughtred, against the slanderous accusations of Richard Delamain, in a Pamphlet called Grammelogia, or the Mathematical Ring, or Mirifica logarithmorum projection circularis.	Fights Delamain comments. Not relevant in timing of publications, as I will use only statements from it without needing a date
5	Oughtred	An Addition unto the use of the Instrument called the Circles of Proportion for the working of Nautical Questions. Hereunto is also annexed the excellent use of two Rulers for Calculation	Appearing at least after 2, it is not relevant when this document appeared as the data in it will be used separately
6	Oughtred	Letter to Allen (including printed drawing by Allen)	We assume this letter is after the publication of document 5. Again, its data to be used separately

3.1 Data on Document Number 2 to prove it is second in time

"While... with mature and diligent care ...went about to do this thing [translating Oughtred papers in Latin], another to whom the Author [Oughtred] in a loving confidence had mentioned this intent, using more haste than good speed, went about to publish with untimely birth and preventing forwardness..."

[regarding the circle of Equal Numbers] *"This fifth circle is scarce of any use..."* [see next paragraphs]

3.2 Data on Document Number 3 to prove it is third in time

"...a comparative attribution delivered by the assumed Author of that with and Index on a Plate [Oughtred] that the way on the plate in a single projection with an index [with two arms] at the centre is a better way than that of my ring..."

[regarding the circle of Equal Numbers] *"though someone said upon the description of it that it was of scarce any use..."*

4 Oughtred Devices

4.1 Logarithmic Rods

From the prologue to document 2: *"he brought me two Rulers of that sort ... to be used by applying one to the other"*

Oughtred shows Forster two rods with at least one logarithmic scale in each of them (like Gunter Ruler). These are two devices, thus, not a slide rule.

Oughtred also recognized that an expert could get to them from Gunter invention (even in a circle). From document 4:

“seeing Joiners, and Carpenters, and other Mechanics about this town, and elsewhere, yea and School-boys, in imitating Master Gunter’s Ruler incurvated only into a circle, might have, and some have drawn, to more good purpose...”

So, with this so-simple description from William Forster of the rods we must conclude that these are not an invention but an expert evolution of Gunter ruler.

4.2 Logarithmic Circle

From the prologue to document 2: *“and after that he showed me those lines cast into a circle or ring, with another movable circle upon it”*.

Forster describes the logarithmic lines set “in a circle” thus having the form of rings in it. Then describes a movable circle “upon” it. As an expert, if that “movable circle” had had at least one scale, he would have described it.

This is also supported by the next phrase by Oughtred from document 4:

“...will prove to be Elias Allen himself: for at his request only I altered a little my rules [design rules] from the use of the moveable circle and the thread to the two arms of the Index.”

Sometimes there is confusion in these texts, as “circle” is used both for a disc and for the circular scales in it. Here “moveable circle” must be understood as a visual ring surrounding the disc with the scales, maybe done as a disc behind that with the scales. In that ring there would be the two hairlines (one fixed to the ring and one movable in it) tied to the discs centre, that Allen substituted by the pair of radial cursors.

I can understand that it would be difficult to guarantee, after some use, the tension of the rotating hairlines, the possibility of the two hairlines being set very near each other, or even the hairline not-breaking at the discs centre. This made Oughtred initial design not suitable for an instrument, (only for a personal prototype).

In summary, having the scales in a disc, instead of in a ruler, is an expert evolution of Gunters device. The novelty here is to combine a disc with two cursors. So, Oughtred did invent the slide rule disc with two cursors.

However, considering the “reduction to practice”, we must also give Allen a part in the invention, as Oughtred prototype was not manufacturable. It was only after Allen added the radial cursors that we have a real device. Also, we must put the date of the invention at the publication of document 2 as there it is where it is first described. No matter how long it took to get the final device, only the final device is the invention.

4.3 On Latin Notes

“He also showed me many notes and rules for the use of those circles and his horizontal instrument, the most part written in Latin. I obtained his permission to translate all of them into English and make public”. [2nd document]

I have already said Oughtred had a prototype. And he also had notes on how he had done it and how it was to be used. And these are the first written indications of a prototype of slide rule.

The notes of printing scales in a disc had the precedence of Gunter invention (as already discussed). And the inventive part (making these in a single device with the “compass” integrated) was not yet finished to be an instrument.

“To whom [Foster], exhorting me to publish them, I said I would not appear to the world in such toys” [4th document]

This is the reason why he did not complete his prototype until after Delamain published and Allen participated in getting the prototype into a real product. As he saw no interest in the use of the prototype, he did not take any further effort into making it a real device, until Forster publication project.

4.4 Cross-Staff

This is described in the 5th document. In summary a cross-staff is mainly made of two long, perpendicular, rods and is used for measurements based in equivalent triangles. Oughtred included logarithmic scales (sines and tangents too) at the edges of both the main and secondary rod (the perpendicular, smaller one) so that to be confronted when the cross-staff was disassembled, thus enabling the respective calculations with those scales. From document 5:

"The Rulers have a square section, all equal-width sides and at right angles. They are divided as follows:

There is a sight (pinnicide) at the upper end of the transverse rod. From it starts the "Line of the Radius", or "Unite Line". The sides of the transverse rod are marked with S, T, N and E letters.

On the left edge of one [the first] of the sides there are the "Degrees", from 0 to 33 degrees. And on the right edge of the same side is the "Line of Sines" from 90 to 1 degree.

In the next [second] side are set two "Lines of Tangents" [at each edge]. On the right edge the line goes upwards from 1 to 45 degrees, and on the left edge the line goes downwards from 45 to 89 degrees.

In the third side, on the right edge is the "Line of Numbers", going from 10 [1], to 1 in two decades.

In the fourth side on the right edge is set the "Line of Equal Parts", and on the left edge are diverse "Chords for dividing a Circle" [for drawing regular figures].

The Staff [the longitudinal rod] at the further end has a socket with a sight (pinnicide) at which a scale starts from 30 degrees to 90 degrees at the other end, near the eye. This scale of degrees is set on the right edge of one of the sides of the Staff.

Then, applying the Transverse rod to the Staff with the lower end set to 90, mark on the four sides of the Staff the "Line of the Radius or Unite", that of "Sines", that of "Tangents" and that of "Numbers", in the same way as in the Transverse rod (the "Line of Sines" being on the side where the degrees are), having the "Line of Tangents" and the "Line of Numbers" continued beyond the "Line of the Radius" to the further end of the Staff.

And on the in the middle of the fourth side of the Staff are double divisions, on the right hand is a "Line of Equal parts" to 100, reaching the whole length of the Staff, and on the left hand, contiguous to the former, is the "Line of Latitudes or Elevations of the Pole" into 70 degrees, marked with the letter L.

...

"Thus, you have the very same lines in the two Rulers as there are in the Circles of Proportion, and you may perform the same calculations with the two Rulers as with the Circles of Proportion".

After this description of Oughtred's cross-staff we see it is a single instrument as cross-staff, but it is two separate rods joined by hand for calculations. Again, we cannot talk of a calculating device, but two devices combined. Then, this is out of our "slide rule" scope.

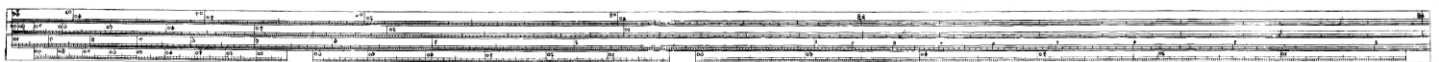
4.5 Oughtred Letter to Allen

In this 1638 letter, document 6, Oughtred gives Allen instructions about how to manufacture his Cross-staff. So, the first conclusion from it is that the Oughtred Cross-staff, as manufactured by Allen, does not exist yet (Oughtred is willing to see it finished). Then:

"The Lines of Numbers, Sines and Tangents are to be set on the Transverse rod in the same manner as they are set in Mr. Gunter's cross-staff..."

This means that Gunter's cross-staff already had at least logarithmic scales (numbers, sines and tangents) in the Transverse rod.

Finally, the letter is accompanied with a drawing that Allen has given Oughtred so that he may clarify manufacturing details. And it is a negative-printing taken from an existing (already manufactured) device.



We can see a ruler with four scales, and none of these is drawn at one of the edges of the device. So, this is totally different from what we would understand a logarithmic rod would be, to be used joined to a twin device. Just refer to the description done by Oughtred of his cross-staff shown before (scales in the edges and in each side of the rod). The conclusion is that the print Allen had provided Oughtred is of a Gunter ruler. Maybe, if we link this to Oughtred letter, we may conclude it is the ruler on the Traverse rod of Gunter cross-staff.

From this point we might conclude that Gunter cross-staff still required a pair of dividers, while Oughtred did not (it had two logarithmic rods designed in his cross-staff). That could be considered a novelty in such a device (avoiding the need of a third element out of the two rods of the cross-staff). And maybe there were other innovative details in the measuring with

equivalent triangles. Those should be compared with a full description of Gunter's cross-staff, out of the scope of this document.

5 Delamain Grammelogia

5.1 Grammelogia First Version

As from document 1:

"The parts of the Instrument are two Circles, one moveable and the other fixed. The moveable has a small pin fixed to it.

The circumference of the moveable circle is divided into 10 unequal parts, representing 1 to 10, 10 to 100, 100 to 1000 etc. or 0,1 to 1...

...now seeing that ten tens make a hundred, there must be 10 divisions between the said 200 and 300 [referring to 2 and 3 main marks], every one of those divisions do represent [a step of] 10, and the mark "+" at the half of said 100 [hundreds] you may read 250, 350, 450...

The numbers and divisions on the fixed Circle are the very same as these on the moveable circle, and therefore the same numbers are in the fixed [scale] that are in the moveable [scale]. For if you move 1 in the moveable [scale] to 1 in the fixed [scale] there is represented for every number or division [in the moveable scale] his opposite [in the fixed scale].

And thus, in these two Circles there is a great body of numbers, the one standing always fixed, and the other to be moved.

...

If a device is composed of three circles of equal thickness A, B and C [A middle, C outer, B inner]. The inner edge of C and the outer edge of A graduated with logarithmic sines, and the outer edge of B and the inner edge of A graduated with logarithmic lines, and then on the backside be graduated the logarithmic tangents and again the logarithmic lines opposite to the former graduations, it shall be fitted for the resolution of plain and spherical triangles.

...

This instrument is made in silver or brass for the pocket or any other size, ... by Ellias Allen.

...

Charles, by the grace of God, King of Great Britain, France and Ireland... whereas Richard Delamain, Teacher of Mathematics, had presented to Us an instrument called Grammelogia, or the Mathematical Ring, together with a Book so intituled, ... being his one invention; we...have granted ... Richard Delamain... privilege, licence and authority for the sole making, printing and selling of the said instrument and book... during the space of ten years... Given ... the fourth of January in the sixth year of our Reign".

I have added the text of the patent rights so that it is known where to read about it. I cannot discuss how patent rights were issued in those times (the experts studying them or the due market research...).

First description in Delamain's first book is of two discs having one decade scale circumference in each one. One referred as fixed and the other as movable. At least, ten divisions per each main division (with a special mark at each fifth one) are mentioned. Thus, it is a single device where logarithmic calculations may be performed by rotating (sliding) one scale against the other. The novelty here is that one disc, or ring, is inside the other and form a stand-alone instrument with a rotating capability. The assembly method is not provided in this description but only "it may be manufactured by Ellias Allen" (to protect manufacturing knowledge rights?).

The second instrument has three concentric rings and is engraved at both sides (faces). From outside to inside I understand it has S / S' , C / D in the front face, and T / T' , C / D in the back face. As the scales are in the ring edges there is no need for a cursor (the same as in the previous design). Also, D / C , T' / T at the rear could be an option...

In any case here we have a sliding disc with no cursor. So, a complete device without cursor. The novelty is in having the two logarithmic scales set in a stand-alone device and not needing a cursor. It is also, then, completely different to Oughtred calculating disc prototype novelty (with a single logarithmic scale and a pair of cursors).

As the book came out the first and the king Charles I confirms there is already a manufacturable device (by Elias Allen) this is the first existing slide rule.

And there is a written description of the first duplex slide rule disc, as far as data from one side may easily be transferred to the other side to continue calculations. Although the coincidence of the starting point of the scales in both sides is not mentioned, it is something an expert may deduce easily.

5.2 Grammelogia Second Version

As Andreas has indicated several times, what is kept from this book seems to have different origins. In other words, the document seems to be made of parts of Grammelogia several versions. I am not even sure if parts of some version-one document are mixed as version two.

But as said before, the text in it shows it was published after document 2 by Oughtred. Therefore, Oughtred was the first in dividing the scales of tangents and sines in several segments confronted to a single-decade D scale. In the description of his instrument there are two scales of sines and four of tangents.

But there are many possible slide rules described, several discs, with or without a cursor, even one in a grill or gridiron shape, and a cylinder with parallel circles. I believe it is better to leave the description of these to another article, but there are a lot of “first time described” in this document version worth re-publishing.

5.3 Design Conflict with Thomas Brown

This issue is related to 1-decade scales designed rotating in several turns. That is, if we design 5 turns, each turn will show one linear fifth of said logarithmic scale. You can see examples of that in Gilson calculating discs and Fowler calculator watches.

There is no data about Thomas Brown device, but only a specimen manufactured by his son, John Brown, by 1660. This instrument has three scales in the shape of a spiral, done by increasing half circles. With a compass you draw one half circle; then move the arm of the compass on its centre an amount to one side and open the arms of the compass (increase the radius) so that the drawing of the next half circle starts at the far end of the previous; and so on.

From outside to inside, John Brown's device has a 5-turn “numbers” scale, a 5-turn “Sines” scale, and a 7-turn “Tangents” scale. The Index, like in Oughtred device, is a pair of radial cursors. It is made of wood with brass index.

Delamain Grammelogia second version compilation does show turning scales. The front pages show two images, the first with a device made of 2-rings with 5-turn C and D scales, and the second a disc with a 10-turn D scale. But these are drawn as full circles, so that to follow the scale your eye has to “jump” from one circle to the next, while there is full continuity in Browns disc.

In document 4, taking the “negative energy” from the text, Oughtred explains that Delamain saw Brown instrument before adding the images and text descriptions of the devices having spiral scales to his Grammelogia second version. While Delamain indicated the changes were due to some errors in some images.

So, none of the devices has a true spiral, (its radius growing progressively, like in Gilson devices) but increase one by circle steps and the other by half circle steps. Brown looks a better design while none of them adds any help to count turns and know in which turn the result (of an operation) lies.

And there is no data to position Thomas Brown in the scenario. He might have been the first, the second, the third, or none, to invent a slide rule, apparently in the shape of a slide rule disc. But Oughtred says nothing about Brown's device being invented before or after his. And Thomas said nothing either.

Even more, John Brown device has the same 2-cursor index. If that was in Thomas Brown device, that could be a prior art in Oughtred calculating disc, now not having novelty, as it would be a gathering of state-of-the-art elements an expert could do.

There is even another option, and that is the disc by Thomas Brown having only linear spirals, that is, with numbers instead of logarithms of numbers, and sines and tangents related to that linear scale. With a single radial cursor tangents and sines could be read (from this “graphical table”), maybe with enough accuracy for his work as a master carpenter (then avoiding having to read these in a heavy book).

In summary, no conclusion possible as I have only alternative conjectures that lead in different paths. We must keep, then, the conclusions that Delamain was first inventor, with two sliding rings, and Oughtred the second, with a disc with a pair of cursors.

In the case Delamain had indeed copied Thomas Brown device (this then being really a calculating disc), this would not affect his initial inventorship, in the same way that nobody doubts Edison invented the common light bulb, although it is known that he patented ideas from the people in his company.

6 Acknowledgements

As said in the beginning, the data and main source of information for this article come from the threads in Groups.io between Andreas Poschinger and Tomas Wetmore, with some other interesting additions done by many others, like Dean, Karl, Colin, John, etc. Many thanks to all for your interest in gathering all available data.

I am the responsible of the conclusions and so these may be discussed (with the sharing of new valid data). I expect this clarifies that time of great evolution to the slide rule and clears the inventorship roles in today's understanding.

As my intention is to publish a second article only with the descriptions of the several slide rules designed by Oughtred and Delamain, (as shown in said documents), I will also add any new data that may have been shared after the first article, and the associated conclusions.

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