

Introduction of Slide Rules in France¹

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Resume

Slide rules truly appeared in France in the early 19th century. Those few earlier references to logarithmic tools that can be found relate to Gunter rules, especially in naval text books. Starting in 1815, Jomard presents the slide rule and asks Lenoir to manufacture it. The first French slide rules are sold in 1821, with the first manuals following soon. Later, Gravet-Lenoir and Tavernier-Gravet take over the manufacturing. In 1851, Mannheim invents the new scale set that bears his name and the next year, mastering of slide rules is a required subject in the technical high schools. This forms the true start of the modern slide rule. The major players in this process of awareness in France will be presented in this paper.

Introduction

Denis Henrion, deceased in 1640, is one of the persons who introduced logarithms in France, in his *Traité des Logarithmes*, published in 1626. That same year, he publishes the *Logacanon*, in which he describes how a logarithmic instrument could be constructed, modelled after the Gunter rule.

An extract from this work (Fig. 1) shows on top the scales of the logarithms, tangents, and sines; the instrument also shows other scales, those for a proportional divider, as well as a complete graphical computing system.

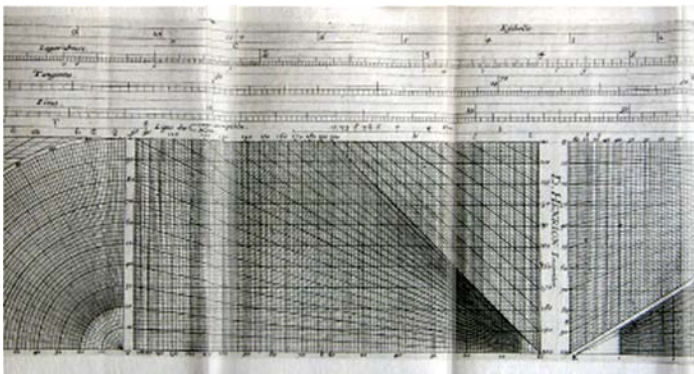


FIGURE 1.
Excerpt from Denis Henrion's Logacanon

Contrary to the United Kingdom, before the 19th century, no mention is made in France of manufacturers of measuring instruments who produce slide rules on a regular basis. The only known logarithmic instruments are all based on the model of Henrion, and thus to all intents and purposes

Gunter's rules, the lone ruler for one-and-a-half centuries. These rules were often called "English rules".

Special mention needs to be made of Joseph Sauveur (1653 - 1716), who at the end of the 17th century publishes the *Eléments de géométrie*, re-issued in 1753 in a corrected and extended form by Leblond and titled *Géométrie élémentaire et pratique*. This work includes the paper *De la règle logarithmique* (On the Logarithmic Rule). Sauveur states that "this rule is useful for calculations in which an error of 0.1 or 0.2 percent can be ignored".

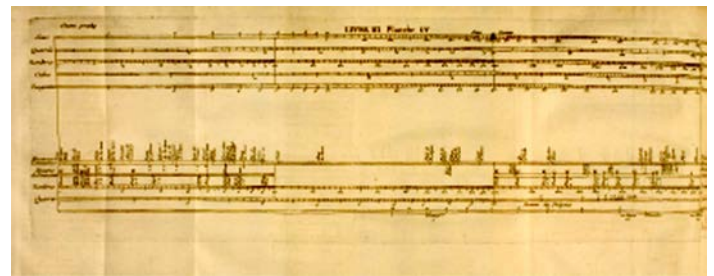


FIGURE 2.
Sauveur's rule

Sauveur adds very little to Henrion. He indicates other uses, for example "if the currencies had a fixed exchange rate, one could add a monetary line". In 1700, he instructs Sevin and Le Bas to construct a rule according to this principle. This brass rule, very well built, is on display at the CNAM museum in Paris.

References to logarithmic instruments can also be found in hydrographic textbooks, especially by Pierre Bouguer (1698-1758). In 1753 he publishes at the request of the Ministry of the Navy, a *Nouveau traité de navigation, contenant la théorie et la pratique du pilotage* (New discussion of navigation, including the practice and theory of piloting), a reference book in all nautical schools. In this textbook, he presents two ways to calculate: the mariner's quadrant and the use of logarithms and logarithmic scales. He also states that he had the intention to construct a circular slide rule, but this does not seem to have materialized.



FIGURE 3.
The logarithmic scales by Bouguer.

Lenoir's first slide rules

Only in the 19th century will the slide rule truly be introduced in France and will it be manufactured in quantity. Not without problems: the role played by a few men, supported by the "Society for the Encouragement of the National Industry", is essential in this period. Let us introduce the prime actors.

Edme-François Jomard

Edme-François Jomard (1777-1862), an early and brilliant student, enters the Polytechnic School in 1794, which is the first



FIGURE 4.
Edme-François Jomard

Étienne and Paul-Étienne Lenoir

Étienne Lenoir (1744-1832, fig. 5) is, in the period that we are interested in, already one of the best known French artists in the manufacture of scientific instruments. He owns a specialized workshop in Paris for the construction of precision instruments, in this period at 340 Rue St. Honoré. In particular, he already uses dividing machines to very accurately engrave the graduations and which he improves on continually. He continues to work practically until his death.

His son Paul-Étienne (1776-1827), just like Jomard, takes part in the expedition to Egypt. It is not known if they have actually met. Later he works with his father in their workshop. The Lenoirs have, as the first in France, manufactured slide rules to be sold in quantity.

"La Société d'Encouragement pour l'Industrie Nationale" (SEIN)

The Society for the Encouragement of the National Industry

year Polytechnic existed. A few years later, he takes part in the expedition to Egypt as a geographic engineer. In 1814, he was sent to England for issues related to Egyptian antiquities; he stays there until the final collapse of Napoleon's Empire. During this stay he gets interested in the slide rule and its use and brings a few samples back home. He then manages to get others interested as we shall see. Jomard continues as a brilliant geographer and, as a known scientist and networker *avant la lettre*, he produces an impressive correspondence, becomes a member of the Institute and other scientific societies, all the time fighting for a generalized elementary education.

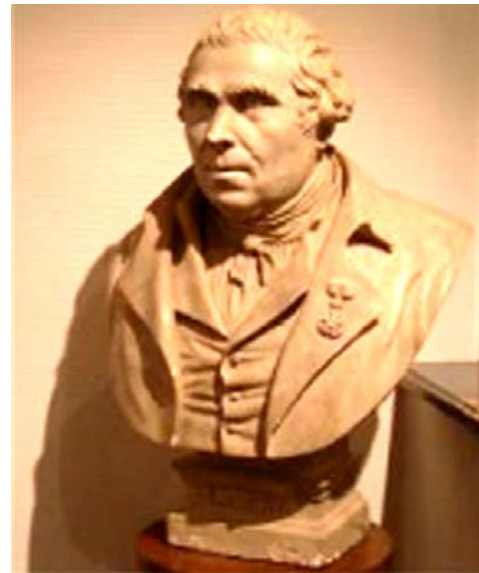


FIGURE 5.
Étienne Lenoir

was founded on 1 November 1801 under instigation of Chaptal, its first president. Its goal is to put science at the disposal of industry and to arouse interest in technological innovation and its awareness. In this period, catching up technologically with England is also an issue. Between 1815 and 1820 and under auspices of SEIN, Jomard will produce a number of publications that we will discuss below. SEIN still exists today.

Jomard's publications within SEIN

Jomard is admitted to SEIN as of 1 January 1815 and his first publication, written within the section of Mechanical Arts, is published in August 1815 in the Bulletin of the SEIN. He describes the slide rule:

"which is a type of machine, today brought to a high level of perfection. It is a way to perform all calculations without pen, pencil or paper [...], and without knowledge of arithmetic. [...] They can serve scientists, engineers, merchants, workers, almost

anyone. [...] It is therefore desirable that its use will become very popular, and that its price will put it at everybody's disposal, but without losing its great accuracy, without which the instrument is of no use. In London, a rule of a foot long costs today about 5 shillings. I believe we could have it manufactured here for 4 or 5 francs."

The slide rule is thus perceived and presented by Jomard as a simple instrument, of general use, accessible to many. It is to be used in everybody's hands and used in everyday life. He has already made contacts to have the slide rules manufactured: the divisions of the logarithmic scales need to be calculated and performed by an able workshop, since the precision of a slide rule obviously depends on the quality of the scales.

"Preparations are made in Paris to manufacture slide rules, adjusted to French measurements and that, without being longer, will have twice the precision of English rules of one foot long. I have entrusted Mr. Lenoir, experienced engineer, with this job. I am indebted to Mr. Corabœuf, captain in the Royal Geographers' Corps, for all calculations required for a perfect construction of the slide rule."

This publication presents a tremendous boost to the introduction of slide rules in France. From this moment on, and with support by SEIN, and especially from Francœur, of the committee for Mechanical Arts, a real interest develops for this instrument.



FIGURE 6.
Soho type slide rule (Plate from Jomard's publication)

The production process and its problems

It takes until 1820 for Lenoir to produce the first prototype of his slide rules. This is what Jomard says in a SEIN publication on 7 February 1821: "The claims we made then [in 1815], are now realized. The first of these rules was registered last year, constructed in copper and with great care; the rules for general use are made of wood". We are dealing here with a registration, undoubtedly to protect intellectual rights, of a type of copper slide rule, which, however, is not the more common rule. But this extract gives very detailed information; in France, at the end of 1820, in the workshop of Lenoir in Paris, the first Soho type slide rule was produced, the first really general purpose slide rule. This model is made of cop-

per, as shown, and is 36 cm long [about 14 inches, note of the translator]. Five years have passed between Jomard's first publication and the manufacture of a slide rule (albeit a prototype), according to his specifications.

Francœur gives us valuable indications of the problems and difficulties that Lenoir encountered:

"Mr. Jomard [...] did not hesitate to acknowledge that it was not enough to describe a good instrument to be built by some and used by others. He confided the experienced engineer Mr. Lenoir, to construct the scales according to his data. The operation was very slow, because of difficulties in the work needed to produce in large numbers and at low price. [...] Mr. Lenoir, who understood well that this invention could not be widely distributed without them being priced affordably, with all the care characteristic of all his products, has developed a machine that marks the divisions on eight rules at the same time, and he will soon be able to add to this number."

"Mr. Collardeau, graduate of the Polytechnique, aware that the rules, with the dimensions of Mr. Jomard, were too long to be easily portable, and had their divisions too close together to be easily used by the common people, had them made at a length of 26 cm [about 10 inches, translator's note]. This young man, entering a career in mathematical instruments, enters the workshop of Mr. Lenoir as an apprentice, where he is now charged with dividing the rules. These rules do not have the same precision as those of Mr. Jomard, but they are more portable, and would in many cases be preferred. Their finish is better than that of the best English rules, to which they have been carefully compared."

Their prices are 10 francs for the Jomard model and 5 francs for the Collardeau type, meaning they are reasonably priced. We find a clear intent of all actors to come up with a slide rule that is affordable. The commercialization starts in the first quarter of 1821. Lenoir has also manufactured a number of more luxurious models, certainly a lot more expensive, because a model exists in the CNAM museum in Paris bearing his signature that is 36 cm long, made of ivory and is shown in a padded box.

The first slide rule manuals

In 1824, the Bulletin of Mathematic Science gives an overview of manuals that have been published. This same notice mentions that Lenoir has organized free courses in his workshop: "We have mentioned a manual published in Dijon. This has served as the basis for a free course of 8 lessons, started on 13 August at Lenoir, [...] and given by Mr. Artur, mathematics teacher. [...] For these rules, three different manuals exist: the first by M. Collardeau, student of the Polytechnique, price 2 francs, a second by Mr. Mouzin, first edition, price 1.25 francs, Dijon; a third one, by the same

author, second edition, price 2 francs.”

A few years later, in 1827, Mr. Artur also publishes a manual, perhaps the product of his courses at Lenoir?

The first manual to be published is the one by Collardeau (Figure 7), in 1820. Actually, Artur mentions in his foreword: “Mister Collardeau, student of the Polytechnique, has published in 1820 the first manual for this instrument, taking an English manual as an example given to him by Mr. Hachette upon his return from England.” The English link is well visible. The edition that we have been able to consult is from 1833. The author (Charles Félix Collardeau du Heaulme or Duhaume, 1796-1869), 1815 graduate of the Polytechnique, is the same one mentioned by Francoeur in his publication on slide rules; he has therefore worked with Jomard and with Lenoir to become familiar with the construction methods. He has also worked a lot with Gay-Lussac, whom he mentions in the beginning of his book, and he has become a precision instrument maker in Paris. For a brief moment he is described as “successor to Lenoir”, but the issue of this succession will be dealt with later. His work on the slide rule is signed “Collardeau”. His manual must therefore have been edited at least once in 1833.

The second we mentioned is Ph. Mouzin, of whom Jomard mentions that he was a lawyer in Dijon and who introduces himself also as a mathematician. His work will have at least four editions between 1824 and 1844, in general in Paris and Dijon.

The third manual finally, is from J.-F. Artur, the same one who gave the free courses at Lenoir. Artur must have known Lenoir for a certain time, because he has produced a manual for the Borda disk, made by Lenoir. He introduces himself as “teacher of mathematics and navigation, associate of the Academy of Science, Arts and Literature in Caen”. The first edition is dated 1827, and it is noteworthy that his book is published, amongst other places, “at Lenoir, who constructs the rules, 340 rue Saint Honoré”. It has known at least one other edition in 1845.

These three books, rather short (that of Collardeau has 92 pages, the one by Mouzin 122, and the one by Artur 155) are set up more or less along the same lines. In each case, they present a relatively new instrument, describe or praise its possibilities, and finally explain how to use it, starting from the simple cases to very complex ones, accompanied by examples and exercises, some of which require a high level of

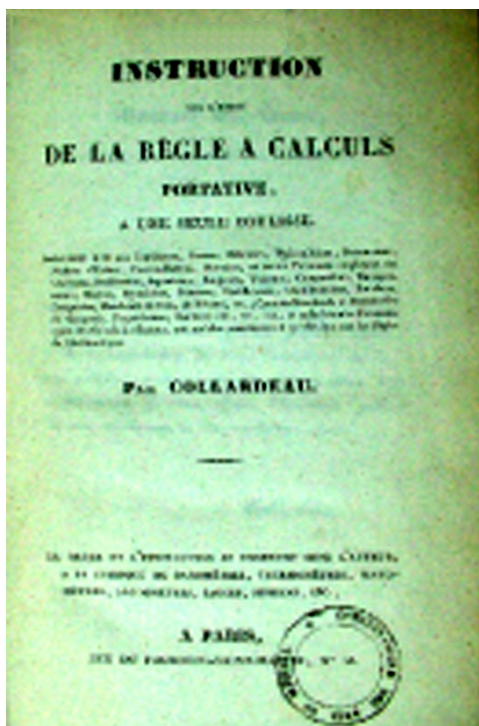


FIGURE 7.
Collardeau



FIGURE 8.
Mouzin



FIGURE 9.
Artur

expertise. Each additionally presents more or less elaborate theoretical coverage of logarithms.

The book by Mouzin is complemented by the following additions: “instrument with the use of which one can obtain visually, without pen, pencil or paper, without tables, with-

out calculating by heart, and even without knowledge of mathematics, the result of all sorts of calculations.” In this case, he describes more what one can do with the slide rule than which areas of application it applies to.

In this respect, the title of the book by Artur has a differ-

ent approach: “Theoretical Instructions and Applications of the Logarithmic Rule or Slide Rule”, without any further detail on this page. We have now moved from “Instructions in Use” or “how to use” to a manual “Theoretic Instructions”, where the use has become the application. At least in the title the book by Artur appears more “scientific”, more oriented to readers familiar with mathematics.

The wordings used to describe the slide rule and its various parts is obviously not yet crystallized: the slide is called “*coulisse*” [“runner”] by all three (Artur also uses the word “*régllette*” [“little rule”, the current term], but the word “cursor”, used by Artur, has nothing to do with the current meaning. Similarly, the word *échelle* [scale] does not quite have the same meaning. It is nevertheless noteworthy that at the end of his work, at least starting with the third edition (1837), Mourzin mentions a cursor, in the modern sense (that is, a small metal or glass piece, later made of plastic, allowing to better align and read off values on the rule), without giving it this name: “Sometimes a copper piece is added to the slide rule that can slide along the instrument. It serves to more exactly align the tick marks of the upper line with those of the sine and tangent. One can even use it to mark a result

of one operation that is to be used in a second operation to arrive at the result.”

Therefore, contrary to what is usually written, the cursor appeared well before the Mannheim slide rule in 1851.

The manuals by Mouzin and Artur have seen several editions, and they have been published during almost twenty years, which seems to indicate that the slide rule has begun to find its way around France.

Two examples of slide rules manufactured by Lenoir

We present examples of two slide rules manufactured by Lenoir. Both carry his signature. One of the main characteristics is that they show two units of length: centimeters and millimeters on the one hand, and *pouces de Paris* [French inches] and *lignes* [not to be translated, 1 *pouce* = 12 *lignes*] on the other hand. This fact dates these slide rules to the 1825-1830 timeframe, because 1830 saw the demise of the old units. The first one (collection E. Pommel) is 26 cm long. The second one (collection M. Thomas) is 36 cm long. Both are made of boxwood. The major difference is in the reverse (see photographs).

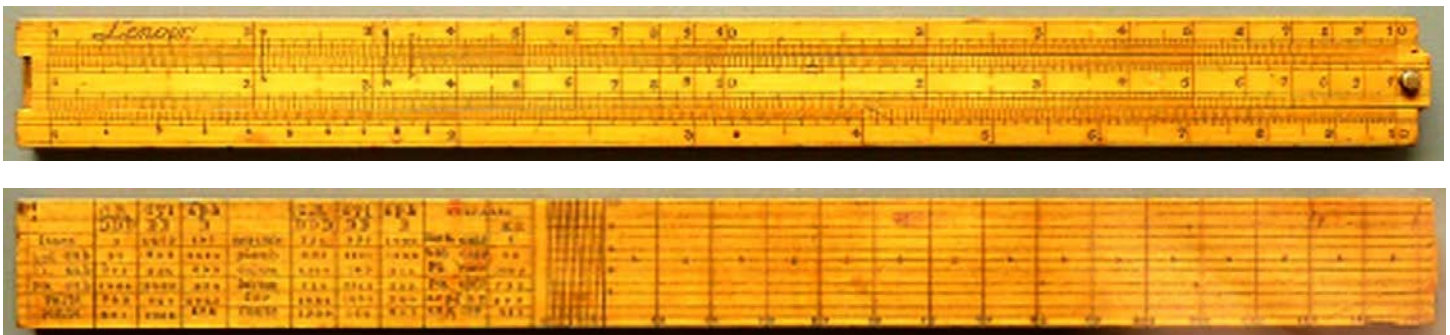


FIGURE 10.
Lenoir slide rule of 26 cm



FIGURE 11.
Lenoir slide rule of 36 cm

One can say that by 1830 the major elements are in place in France for a real widespread use to begin; manufacturers are ready, the slide rule models have been defined, the prices are affordable, instruction manuals exist, articles appear in

magazines. The scientific world knows that the instrument exists and that it answers to a certain need. It is still far from a massive use.

The successors to Lenoir

Étienne Lenoir dies in 1832; his son Paul-Étienne had died in 1827. One of his employees, named Mabire, takes hold of the

workshop at the address 14 rue Cassette in Paris. But it is Gravet who really succeeds Lenoir as far as slide rules are concerned. Who is he? We know hardly anything about Monsieur Gravet. Is he a manufacturer of scientific instru-

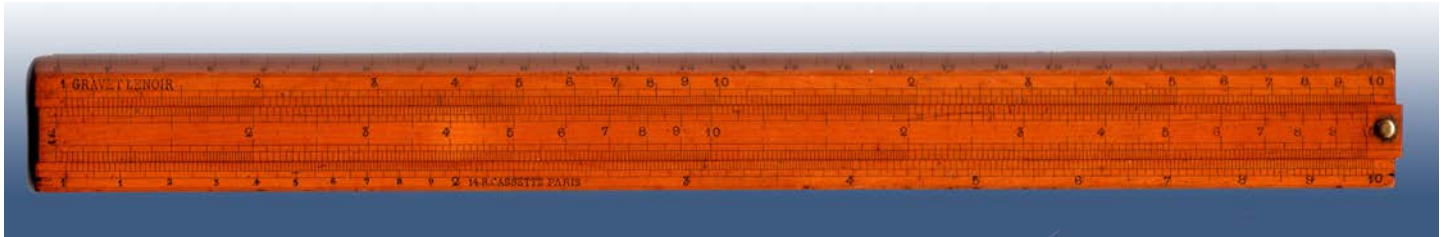


FIGURE 12.
Gravet-Lenoir slide rule

ments, perhaps spectacles? Is he a pupil of Lenoir? Did he work in Lenoir's workshop? In any case, he was well known in 1844, when he receives a bronze medal from a jury in a contest for precision instruments for a mirror level. The jury report also mentions a compass, but one line is especially interesting for our discussion: "his slide rules are so much favored today that we believe they don't need our praise here." His address is the same as that of Mabire, and therefore Lenoir: 14 rue Cassette. One can also find in a booklet of 1843: "sold by Gravet, successor to Lenoir, manufacturer of scientific instruments and slide rules". How did this "succession" come about? Gravet seems to have gotten away with it, because he soon sells his slide rules under the name of GRAVET LENOIR and mentioning the address 14, R. CASSETTE PARIS (figure 14) and the name of Mabire does not appear anywhere anymore.

The slide rules manufactured by Gravet are of the same type as those of Lenoir, and very well constructed. Later, the brand bears the name of Tavernier-Gravet who manufactured very high quality slide rules, but that falls outside the scope of the current paper.

Dissemination Military

Without doubt, the military was amongst the users. We find an indication in the Belgian Military Revue of 1841, in which we find an "Instruction for the use by officers and NCOs of all branches on how to use the slide rule, applied to different branches of the military."

The slide rule thus finds favor with the Belgian army! It is added that "The use of the slide rule is not widespread [in France]; today it begins to be more appreciated by our neighbors. In Belgium it is still hardly known." This extract shows that only by 1840 is the slide rule achieving widespread use in France.

Usage by the major schools

A few enlightened minds, civil or military, would not have been sufficient to give a major boost to the dissemination of slide rules. Still, from 1829, the slide rule is part of the equipment required on entry at the Central School for Arts and Manufacture, a private school that has just been created. In 1853 P.M.N. Benoît publishes a manual "The slide rule explained"; the introduction states:

"All these efforts would probably have taken a long time, in view of the current indifference in France, for improvements that don't translate into immediate material benefit, had the Government not wisely imposed, in its Program for the Entry into the Public Services Schools, knowledge of and experience in the slide rule, which Mr. Collardeau and Mr. Gravet, successor to Lenoir, continue to manufacture with a remarkable precision."

We see that by 1852 knowing how to handle a slide rule had become mandatory to enter the major public schools, which leads of course to all candidates to learn to master and procure one. This decision by the government was therefore responsible for the quick uptake of the slide rule in France. Still in this same period, Giraudet publishes a small booklet of 24 pages, *Instructions for the use of the slide rule for the candidates of the École Polytechnique and the École Militaire of Saint-Cyr*, clearly in line with the government decision mentioned above.

Final Remarks

Amedée Mannheim (1931-1906) is the key person to truly embed the slide rule in the modern era. Graduate of the Polytechnique (1848), he studies artillery in Metz and there in 1851, as a young second lieutenant he develops an im-



FIGURE 13.
Amadée Mannheim

proved slide rule. Mannheim changes the layout of the scales and provides it with a cursor to transfer the values from one scale to another. This improvement results in each scale appearing a maximum of two times, freeing up the slide to include other scales and thus greatly improving its usefulness. His publication is entitled "Slide rule modified by Mr. Mannheim". It is signed Metz, December 1851, A. Mannheim, graduate of the Polytechnique, second lieutenant (in training) of the artillery (he is only 23 years old). It is a simple booklet of four pages.

From then on, we can consider the slide rule to have entered its modern period in France as well as in the rest of the world, which is to last more than a century.

Note

1. English translation by Ronald van Riet of this article on *L'introduction des Règles à Calcul en France*, IM 2010 Proceedings, p 21.

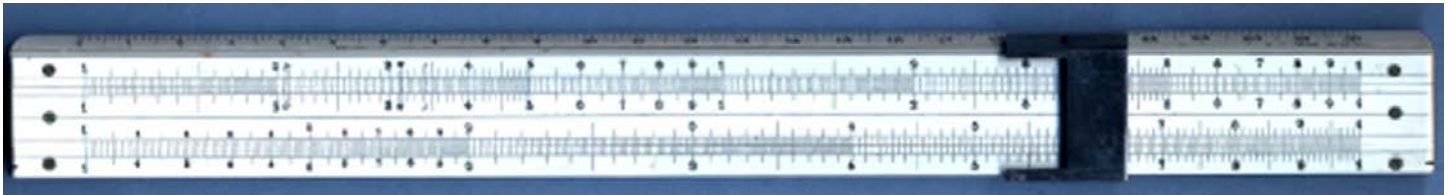


FIGURE 14.
Mannheim type slide rule

References

1. Artur, J.F. *Instruction théorique et applications de la règle logarithmique, ou à calculs*. Paris, Casilian-Goery, Lenoir, 1827.
2. Benoit, P.M.N., *La règle à calcul expliquée*, Paris, Mallet-Bachelier, 1853.
3. Bouguer, Pierre. *Nouveau traité de navigation*, Guérin & Latour, Paris. 1753.
4. Collardeau, Charles, Felix, *Instruction sur l'usage de la règle à calculs*, Paris, Thuau, 1833.
5. Coll., *Bulletin des sciences mathématiques, astronomiques, physiques et chimiques, tome deuxième*, Bachelier, Paris, 1824.
6. Francoeur, *Rapport sur les règles à calculer de M. Jomard*, Bulletin de la Société d'encouragement pour l'industrie nationale, 20^e année, Paris, Huzard, pp. 77-79, 1821.
7. Henrion, Denis, *Logocanon ou règle porportionnelle*, I. Bourriquant, Paris, 1626.
8. Henrion, Denis, *Traité des logarithmes*, chez l'auteur, Paris, 1626.
9. Jomard, Edme Francois, *Description d'une règle à calculer etc.*, Bulletin de la Société d'encouragement pour l'industrie nationale, 14^e année, Paris, Huzard, pp. 179-190, 1815.
10. Jomard, Edme Francois, *Rapport sur l'instruction de M. Collardeau pour l'usage de la règle à calculer*, Bulletin de la Société d'encouragement pour l'industrie nationale, 20^e année, Paris, Huzard, p4, 1821.
11. Jomard, Edme Francois, *Rapport sur une nouvelle instruction a l'usage de la règle à calculer, faite par Monsieur Mouzin*, Bulletin de la Société d'encouragement pour l'industrie nationale, 23^e année, Paris, Huzard, pp. 129-132, 1824.
12. Mouzin, Ph., *Instruction sur la manière de se servir de la règle à calcul*, (4^e édition), Paris, L. Mathias, 1844.
13. Otnes, Bob and Schure, Conrad, *Early French slide rules in various collections*, Journal of the Oughtred Society, Vol. 11, number 1, pp. 28-31. 2002.
14. Sauveur, *Géométrie élémentaire et pratique, sans nom d'éditeur*, Paris, 1753.
15. Thomas, Marc. *L'introduction des règles à calcul en France (1614-1852)*. Mémoire de Master d'histoire des sciences et techniques, Université de Nantes, 2009, to be published.
16. Wells, Francis and Wyman, Tom, *La règle à calcul: Lenoir, Gravet-Lenoir and Tavernier-Gravet slide rules*, Journal of the Oughtred Society, Vol. 11, number 1, pp. 23-27, 2002.