The Back-Light Screen Projection Slide Rule

Jay Francis

Finding the Slide Rule

It was raining that Monday, in April of 1999, when I got the call. The caller said he knew I collected slide rules, and asked if I would be interested in a projection slide rule he had. Actually, he had two of them. He started to describe them. At first, I could not understand what he was talking about. I was trying to visualize a transparent slide rule like the Pickett PR series, where one places the slide rule on top of an overhead projector. He kept saying something about a built-in back-light screen, and you did not need a separate projector. Finally, I said that I would have to see it.

So a couple of days later I took a long lunch hour and drove out to his house. Now I know why he gave me such precise directions to his driveway. "Drive exactly 1.2 miles east..." of a certain intersection, "and look for my name on the mailbox." I turned into the driveway just past the mailbox. Actually, it was more like an empty field. He did say his house was "back off from the road". I drove about a quarter of mile on this dirt/gravel driveway into the field. Good thing I had an Explorer with a little higher road clearance than a car. This driveway was rather slippery and muddy after the rain a few days earlier. As I approached what seemed the end of the field, I noticed a house off to the right up a slight hill. Oh great, a hill! With this mud, I was wondering if I could make it. Fortunately, there was sufficient gravel in the "driveway" to provide enough traction. What we collectors will do in pursuit of a slide rule!

Figure 1.

Description and Condition

When I pulled up to the house, the owner was walking out toward my vehicle. He was very friendly and invited me into his home. It was apparent that filing and organized storage were not his forte. However, sitting on a small table right near the door was one of the projection slide rules. Immediately, after my eyes focused upon it, I realized why I had such difficulty understanding what he had tried to describe. I had a preconceived vision in my mind as to what it was. And that vision was clouded with the only types of projection slide rules I had previously seen or read about. This item was totally different. It was about the size of shoe box, turned on its side. Refer to Figure 1. Yes, there was a projection screen built into a slide rule. Along both sides of the screen were scales labels. Some of the labels did not make sense to me at the time. I later learned that they were in Italian, since the unit was made in Italy. There was a power cord running out the back of the unit, and a typical on/off switch on the front.

Before I had a chance to ask the purpose of the three knobs on the top of the unit, he started to open up the projection slide rule. As soon as the cover was removed the design concept was apparent. The design of the slide rule was very elementary. Refer to Figure 2. A light bulb creates a light source. That light travels through the first lens, then through a pair of glass discs, a second lens, reflects off a mirror, and is projected onto a screen. Figure 3 provides a little more detail. The heart of the projection slide rule consists of the pair of glass discs. These discs are approximately 4 inches in diameter. Figure 4 shows a close-up of the discs on the better of the two units.

Figure 2.

Figure 3.

Figure 4.

Figure 5.

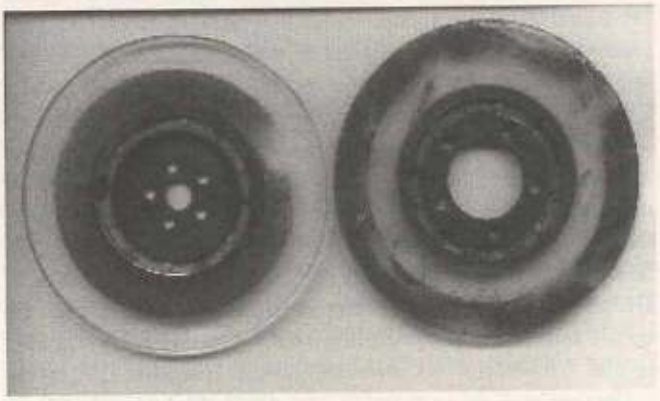


Figure 6.

On the top of the slide rule were three knobs. A close-up view of the knobs or dials is shown in Figure 5. The larger two concentric dials are used to turn each of the discs, respectively. The smaller third knob is used as a vernier adjustment for the inner or top larger knob. The hole in the cover, as seen in Figure 5, was for a locking knob that was missing. This knob was designed to lock or stabilize the outer dial, so that the inner dial could be rotated to make the calculation.

As I mentioned, there were two units. One is in fair to good condition, while the other one is in very, very bad condition. I disassembled the second unit and removed the glass discs. They are shown in Figure 6. The background on half of each disc is shaded, while the scale numberings and hash marks are transparent, like the image on a photographic negative. The disc on the left has four scales on the inner portion, while the other disc has five scales on the outer portion. Thus, when the discs are placed on top of each other, the clear area of one disc will align with the scales of the other. The discs of this second unit were almost totally unreadable, due to dirt, dust, rust, and missing sections of the scales.

One interesting observation. The disc with the inner scales on the second unit was 1/8 inch thick, while the disc with the outer scales was 1/16 inch thick. However, both scales on the first unit were 1/16 inch. My speculation is that the company was experimenting with glass thickness as they were making the prototypes.

The transformer primary has numerous taps so that the unit is compatible with 110 or 220 volts. The bulb was of a very unusual size and shape, although the voltage was of the common 12 volts. The bulb is shown in Figure 7. The socket is of a design that I have not seen before. Fortunately, a spare was included with each unit. The spare can be seen in the lower left of Figure 2.

Figure 7.

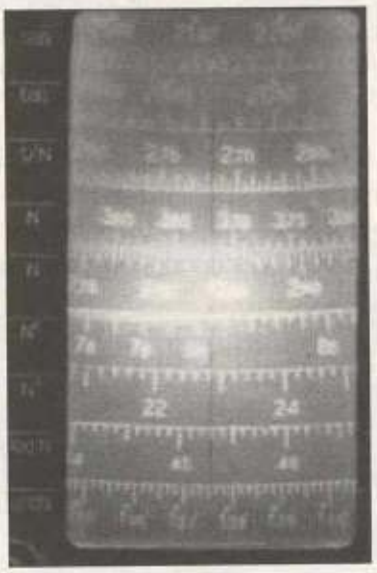


Figure 8.

Repair

While I was at this gentleman's house, he did say that the units did not work. He plugged them in and got no illumination. I thought the worst. I thought that the transformer was probably shot. After I brought the slide rules home, all I did was take some photographs of them, so that I could bring the pictures to the 1999 Oughtred Society meeting. After that, I just put the slide rules aside. They sat for almost a year, until I got around to really looking at them. It always takes something to get me motivated. This time it was a commitment I made to write an article for the *Journal* about these projection slide rules.

So one weekend in February, 2000, I decided to see if I could get at least one working. I decided to concentrate on the unit that was in fairly good condition. The second unit is a lost cause, and I will only use it as a supply of parts. The first thing I observed was the dirt and dust all over the unit. There was the typical dust that can accumulate for almost 50 years. Also, there was an insulator on the base of the unit that was used as a grommet to seal the unit. This grommet had deteriorated terribly. There was residue from this grommet all over the unit. This dust and grommet residue was more unsightly than anything. It did not directly affect the operation of the unit. I plan to clean it up at a later date. After all, I had a press deadline to make.

The first thing I checked was the primary of the multi-tap transformer, making sure the wiring was set for 110 volts. I also gave it the once-over for proper connections and no shorts. I decided to be brave. I plugged the cord in and turned on the power. As the previous owner had said, there was no illumination. Then I got out my trusty pocket voltmeter. Ah, no power at the input of the transformer. The cord had disintegrated due to age. So I just cut it off and threw it away. Being impatient, I hooked up an AC test fixture I had made many decades ago. It has alligator clips that I used to connect to the internal wiring at the primary of the transformer. It is also fused for safety. Later, I will replace the cord with one of like construction.

After I double-checked the wiring, and made sure the alligator clips were not touching the housing, I crossed my fingers and flipped on the power switch. I really was expecting to see sparks or smoke. With age, the insulation in the transformer and on the wires can become brittle. After all, it is almost 50 years old. But instead, I saw the bulb illuminate.

Scales

I turned to look at the front of the unit. And saw the scales projected onto the screen. I was impressed. I did notice some smudge marks on the discs, and some numbers were obscured. But overall, the projected scales were in very good shape.

I made two early observations of the projected image on the screen. First, there was a curvature of the scales on the screen, as can be seen in Figure 8. Second, there was a concentration of the illumination in the center of the screen as shown by the glare in Figure 8. Now that I had the scales projected onto the screen, I could read the scales and try to determine what the labels meant. A little reverse engineering was needed here. As can be seen in more detail in Figure 9, the labels on the nine scales were: sen, tan, $1/N$, N, N, N^2, N^3, $\log N$, archi. I could guess on the first eight. I speculated that "sen" might be the sine scale and "tan" the tangent scale. The $1/N$ was obviously the inverted scale. The N scales were the fundamental scales with only one cycle. The N scales correlate to the familiar C and D scales on the slide rules with which we are all familiar. The N^2 and

N^3 are the square and cube of the N scales, respectively. Log N was also obvious. The only questionable scale was the "archi". The movement between the two discs could be seen between the two N scales. When you turn the inner dial on top of the unit, the top four scales on the screen turn. The outer dial turns the lower five scales on the screen.

Figure 9.

I grabbed my favorite slide rule, the Post 1460, and confirmed that the "sen" was the sine of N, where N was between 0.1 and 1.0. The "tan" was indeed the tangent of N, where N was between 0.1 and 1.0.

Okay, but what was the "archi" scale? By close comparison to my faithful Versalog, I determined that this was the sine of N where N was between 0.01 and 0.1.

This slide rule also has a significant level of accuracy:

- Between 1.0 and 1.5 on the N scale, there is complete labeling of the graduations to a full three digits. Plus there are five hash marks between the tertiary graduations. This provides what I will call 3-1/5-digit direct readable accuracy.

- Between 1.5 and 4.0 on the N scale, there is complete labeling again of the graduations to full three digits. Plus there are two hash marks between the tertiary graduations. I will call this 3-1/2-digit direct readable accuracy.

- Between 4.0 and 8.0 on the N scale, there is complete labeling of the graduations to full three digits without any hash marks between them. I will call this 3-digit direct readable accuracy.

- The remaining portion of the N scale between 8.0 and 10.0 has complete labeling of the graduations to two digits with five hash marks between them. I will call this 2-1/5-digit direct readable accuracy.

  Of course, one can extrapolate to a greater degree of accuracy across the whole scale(s).

Considering that the Versalog has 3-digit direct readable accuracy between 1.0 and 2.0, 2-4/5-digit between 2.0 and 4.0, and 2-1/2-digit between 4.0 and 10.0, this projection slide rule can provide a greater level of accuracy.

I wanted to estimate the equivalent scale length of this slide rule. Since the log N scale is the only linear scale, I measured the distance between 0.00 and 0.01 at 7/8 of an inch. Extrapolation results in a scale length of 75 inches. Granted, the scale length does not compare to the Thacher (30 feet) or the Fuller (42 feet). However, I believe it is significant for a potential production slide rule considering the size of the unit.

Another observation of this slide rule: The "sen" (sine) and "tan" (tangent) scales divide into degrees and minutes, instead of the degrees and tenths of degrees on the Post 1460 that I am used to.

Company History

The company, Filotecnica Salmoiraghi, made only five of these slide rules in 1951 as prototypes. Considering the fact that the normal survival rate of collectable items is only one percent, I feel very fortunate to have found two of them. The company logo can be seen on the front of the slide rule in Figure 10.

Figure 10.

Ignazio Porro (1801-1875) founded the factory in 1864, in Milan, naming it Filotecnica. Porro was a skilled constructor and inventor—often ahead of his time—of optical and geodesic instruments. He designed the anallaptic telescope, a system of variable focus lenses (now known as zoom lenses), and an arrangement of prisms for the straightening of images in telescopes and binoculars (known as "Porro's vehicle"), enabling him to produce more compact and manageable instruments. He also produced levels, theodolytes, transits and distance-measuring telescopes.

After living and working in Piedmont, Paris, and Florence, Porro established himself in Milan, where he taught at the newly opened Polytechnic. Here, one of his students was the young engineer, Angelo Salmoiraghi, who later went on to help him substantially in running the factory. In 1871, he became a partner, taking over the factory in 1877. With Salmoiraghi, the company expanded. By 1890 there was a workforce of around 150,

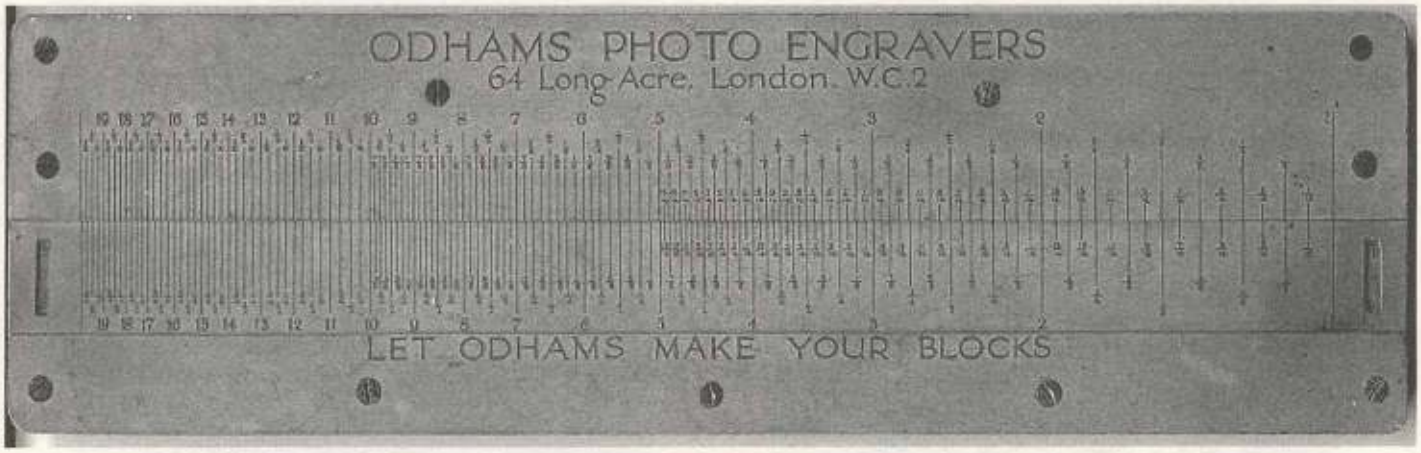
and the factory covered an area of 1500 square meters. The catalog contained over 300 items, including astronomical instruments, telescopes, geodesic, topographic, navigation, and drawing instruments. The items built were of excellent quality and obtained numerous successes at the universal exhibitions. The company, known as Salmoiraghi, still exists today, but in the mid-seventies it stopped producing instruments.

I have their catalog from 1964 that shows them making surveying instruments, ophthalmic instruments and lenses, optical instruments for military use, annunciators and controllers, and mathematical and drafting instruments.

References

Brenni, Paolo & Misiti, Massimo. (1986) Costruttori italiani di strumenti scientifici del XIX secolo. Nuncius, 1:141-184.

Unique Use for Slide Rule as Advertisment



Conrad Schure

We have all seen many examples of slide rules or slide charts as useful advertising items. This one is the most unusual slide rule that this author has ever encountered. It is a working slide rule, with logarithmic scales (ranging from 1-20, running from right to left), and the intervening integers are fractional rather than decimal.

However, what we think makes this example unique among its contemporary advertising pieces, is that it is constructed of zinc plates mounted to a fairly substantial walnut base. The zinc plates are photoengraved with all of the lines, numbers, and letters forming the slide rule, as shown in the accompanying illustration (Fig. 1). The photoengraving was done quite accurately so as to demonstrate the capabilities of the advertiser: "Odhams Photo Engravers, at 64 Long Acre, London. W.C.2". The combination of the zinc plates and the walnut base makes this a fairly substantial item measuring 11-1/4 inches by 3-1/8 inches by 5/8 inches (in thickness).

It is quite obvious that this item was made specifically to be a usable advertising desk piece, because all of the engraving was done as the eye would perceive it, rather than reversed, as it would be for actual printing plates. We believe that it might have been useful for those in the printing trade (for page layout, etc.).

The objective of this interesting advertising piece is also quite apparent from the self-proclaimed motto inscribed in the lower portion of the frame: "Let Odhams Make Your Blocks."

The Robinson Calculator

Conrad Schure

Only occasionally does one find an unusual and interesting variant of a well known calculating instrument (see also the article by Hopp in this issue). Such is the case with the Robinson Calculator. It bears great resemblance to the more familiar Bouchers, Fowlers, Mechanical Engineers, and other circular calculating devices. In size it is just slightly larger than the smaller Fowlers (the Robinson is 2-7/8 inches in diameter, and just over 1/2 inch thick.

However, upon close examination of Fig. 1 the reader would notice that there are no apparent "winding knobs", as on the other examples mentioned above. An even closer examination of the figure (next page) would reveal