John R. Dempster, The Remarkable Dempster RotaRule and the Extraordinary Dempster Family

W. Richard Davis

The Dempster RotaRule has been previously described in two excellent articles, one by Rodger Shepherd [1] and the other by Richard Smith Hughes [2]. This article contains new material about the RotaRule, its exceptional inventor, John R. [Ross] Dempster and a brief history of the Dempster family. For details about the RotaRule scales and other technical features please see the previous two articles.

Early Dempster History[1]

The story of the Dempster RotaRule really begins with the 1850 arrival of Clancey John Dempster from New York to bustling San Francisco. In the 1850s San Francisco was an exciting place because of the 1849 gold rush and the fact that California had just become the 31st state. This was truly the land of opportunity! Clancey joined Daniel L. Ross' shipping and merchant business. This company imported products from the east coast for California customers. Figure 1 shows the company letterhead with Clancey J. Dempster's name. On July 5, 1853, while on one of his East coast buying trips, he married Mary Elizabeth Ross in New York City. The couple had five sons, Milen, Clancey, Daniel, Louis and Roy – all with the middle name Ross from their mother's maiden name.

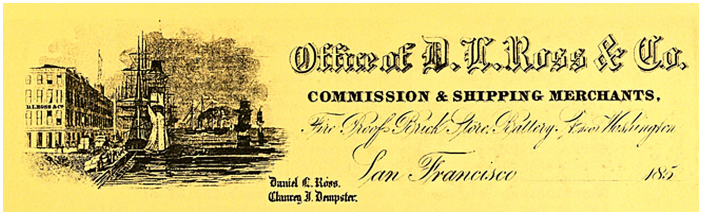


FIGURE 1.
Early Dempster Letterhead from San Francisco

Roy, the youngest brother, graduated from the University of California at Berkeley in 1895 with a degree in natural sciences. This was the beginning of a family "tradition" of graduating from U.C. Berkeley. Every year from 1918 to 1931 there was a Dempster attending U.C. Berkeley2, not only Roy's children, but also those of Clancey's other sons! Because he was the first and only college graduate from Clancey's sons, Roy was chosen to manage some of the family businesses, including wholesale lumber.

Roy married Olive Harper, a teacher, on August 15, 1899 and subsequently had three sons and a daughter, including John R. Dempster in 1903. Shortly after John was born the family moved to Lake Merritt across the bay in Oakland. Unfortunately their Lake Merritt home shifted off the foundation and was lost in the 1906 earthquake. During the earthquake, Fred, Roy's oldest son recalls, "Johnny was in a rolling crib and our mother was trying to chase him all around the room during the shaking."[2] The loss of his home and the disaster in San Francisco made a lasting impression on Roy R. Dempster.

The Dempster Home [3]

After the 1906 earthquake Roy moved his family to Berkeley where he designed their new home to resist earthquakes. The firm of Kidder and McCullough began construction in 1907 and completed the job in October of 1908. Roy closely supervised each step of the construction. Large structural beams were used and the home was bolted to the foundation. Boards were attached to the outside of the studs in a herringbone pattern to provide increased shear strength (just as plywood does in today's construction). A fire hose and water supply were included on each floor. The home was located on a steep hillside overlooking Spruce Street in north Berkeley and had an intriguing and distinctive mixture of brown shingle and remnants of the Victorian era. See Figure 2 for a photo of the Dempster Home. An octagonal tower with a steep "witches cap" roof over the entrance is a legacy of the 1880s and 1890s. The home, however, was an approximate rectangular shape with an open-gable roof with deep sheltering eaves. The large entrance porch repeats the shape of the tower and was sheltered by an octagonal-shaped roof supported by square posts and exposed beams and brackets. The home appears to be wrapped in porches, but these were actually designed to give increased bracing to the home. Roy was very meticulous in his design as is evident by the fine and intricate interior woodwork, including built-in cabinets, the octagonal-shaped "office" and parlor and other innovative features.

FIGURE 2.
Dempster Home in Berkeley

The home also included a basement workshop, which John R. Dempster would soon use for his RotaRule project. Roy R. Dempster passed away on October 3, 1941.[2] Olive Dempster passed away on December 19, 1947 at which time John inherited the home.[2] The home is still owned by a Dempster and has been used to raise five generations of Dempsters.

Note: The current residents of the Dempster home do not wish to be disturbed or contacted in any way. Please direct any questions about this paper to the author.

John R. Dempster

One of four children, John grew up in Berkeley and attended the nearby University with his brothers, Fred (MS Chemistry) and Richard (PhD Physics) and his sister, Barbara (BS Letters and Science)[3]. Roy, John's father had selected his home's location to be within walking distance (1 mile) of the University. John, shown in Figure 3, graduated with honors in 1925 with a degree in mechanical engineering. John, like his father Roy was a detailed thinker, very meticulous, and clever. He was a good athlete and was a member of the University swimming team. He also liked to hike and made the "first assent" of several rugged peaks in the Sierra Nevada Mountains and the Trinity Alps. In 1928 while on a hike with his fiancée, Anna Ramsperger, and another couple an unexpected snowstorm caused them to become lost in the mountains of Lake County in northern California for six days. His mountaineering and mechanical skills were credited with saving them [4].

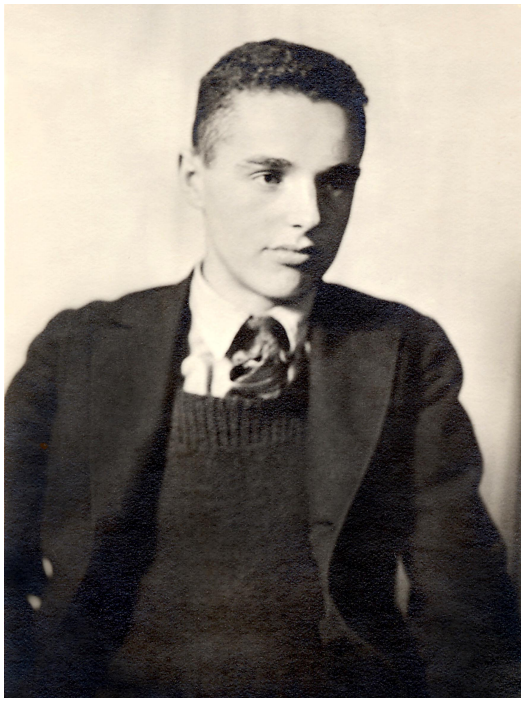


FIGURE 3.
College Photo of John R. Dempster

John did most of the design and construction work on a removable dam on Sonoma Creek near the family's cabins in Sonoma County in 1923. John's detailed typewritten instructions describing how to install and remove the dam still exist today. The first cabin had been built years earlier, in 1906, while the new Berkeley home was being designed and constructed. During this time Roy's family had lived nearby in tents.

John married Anna in 1931. They had two children, William (Bill) Dempster and Janet L. Dempster. John liked steam trains and often took Janet to the Berkeley train station to watch the trains go by. Always looking for ways to educate his children, John used the example of these heavy trains to teach his daughter about inertia.[4] He was also interested in astronomy and liked to watch comets in the night sky east of Berkeley.[4] In the 15 years prior to his death in 1964, he worked at the University of California making lecture demonstration models for the engineering department. He also designed and built a large case to display fluorescent minerals.[5]

RotaRule Design

While John studied engineering he became intrigued with the workhorse of engineering calculations, the slide rule. Sometime before or after his 1925 graduation he decided he would design and manufacture a circular slide rule. A quote from his RotaRule manual gives a clue to his thinking: "By using the circular type, longer scales are obtained on a pocket rule than are found on the usual 10-inch straight rule (which will not fit the pocket), all trouble from running off the end of any scale is eliminated; it is impossible for the hair line to get out of alignment with the scales and a large area is available on the face of the instrument so that more scales may be included [5]." In April of 1928 John applied for a patent covering his RotaRule.[5] In September of 1928 John applied for a second patent covering an improved version of his RotaRule.[6] This indicates that John had built prototypes in 1928 and had developed design improvements to make the operation smoother and allow for fine adjustments. These improvements were used in his model A RotaRule and later in his updated version, the model AA. In late 1928 he began manufacturing his model A RotaRule in Berkeley. Table 1 shows the known RotaRules by serial number [6].

John's model A RotaRule design had 23 scales including his now famous 50-inch spiral C and D scales and surveying stadia scales. He carefully designed 5-foot diameter models of his RotaRule using steel plates. Figure 4 shows the front side of a model AA steel plate with a tape measure showing 60 inches. Using what would become commonplace in the 1960's integrated circuit industry, John then photographed the 5-foot model and photo-reduced it to the 5.25 inch RotaRule size. John was obsessed with accuracy and by using this technique the difficulty of achieving dimensional accuracy on a 5.25 inch RotaRule scale was greatly reduced. Percentage accuracy, however, remained the same. The photo-

TABLE 1.
List of known existing RotaRules

Serial Number	Model	Magnifier present*	Leather Case (Dietzgen)	Manual	Date of Purchase
40	A				1928
115	A				
145	A	RD			
181	A	OR		Y	
218	A	RD			
329	A				1930
426	E (AA)				
481	AA	OR	Y	Y	
486	AA				
510	AA				1934
647	AA		Y		
710	AA				
808	AA	OR	Y		
882	AA	RD	Y		
912	AA		Y		
927	AA				1935
966	AA		Y		
1153	AA	OR	Y		
1268	AA				
1293	AA	RD	Y	Y	
1477	AA	RD			
1513	AA	RD			
1514	AA				1942
1530	AA		Y		
1633	AA				
1640	AA	OR	Y Dietzgen	N	1940
1714	AA				1943
1791	AA	OR	Y Dietzgen		
1886	AA	Y			
1975	AA				
2046	AA	OR	Y		
2126	AA	OR	Y Dietzgen	Y	
2256	AA	OR	Y	Y	About 1948
2350	AA				

*OR = original
RD = duplicate

reduction, in the form of a heavy 0.25” thick glass plate, was then used to make the metal die plates with raised numbers and scales to form indents in the RotaRule disk and ring. In the integrated circuit industry this process is known as photolithography.

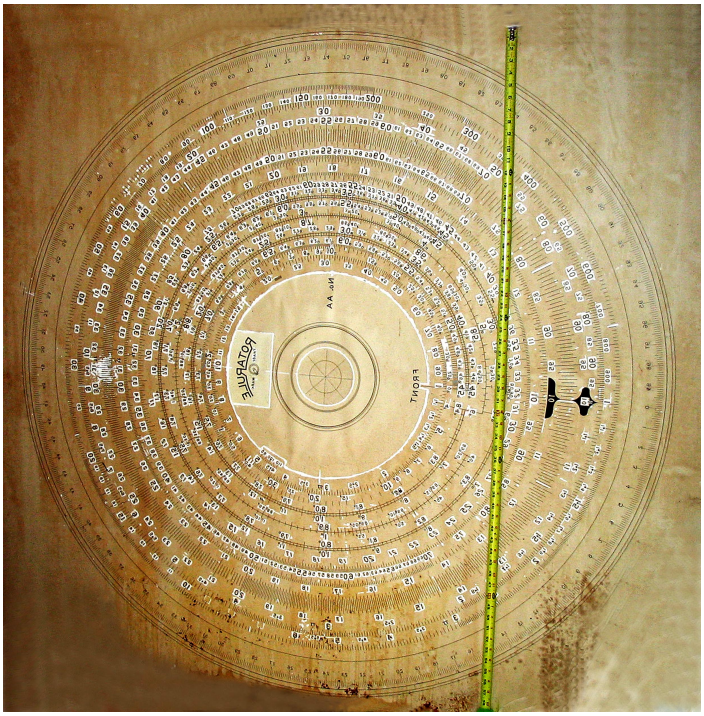


FIGURE 4.
Five-foot RotaRule pattern on a steel plate

For the body of his RotaRule, John selected a new material known as Vinylite [7]. Vinylite was first produced by the Carbide and Carbon Chemicals Corporation (later Union Carbide Corporation) in 1927 in Charleston, West Virginia. It was flexible, tough and inert, free from odor and taste, lightweight and colorless – thus with additional chemicals it could be produced in many colors. The Vinylite that John used was pure white, smooth and had a relatively hard surface. It was supplied as a resin in granular form. During the war the Vinylite arrived with small black granules [probably Bakelite] mixed in with the white granules. Anna, John’s wife, spent many afternoons with tweezers separating out the black particles to prevent unwanted black spots from appearing somewhere on the RotaRule surface.[7]

Each Rotarule carried a model number (A or AA) that was pressed into the Vinylite when the slide rule body was made. The consecutive serial numbers were added after the slide rule was complete, probably using a heated number stamp. It is unknown exactly when John switched from the model A to the model AA, but it is thought to have occurred between serial numbers 364 and 436 [8]. The Dempster family still has RotaRule #426 (see Figure 5) with model AA scales, but it carries a model “No. E” - maybe this stands for “Experimental”. Since this RotaRule would have been made with a separate set of die plates, this may actually be the “transition” model!

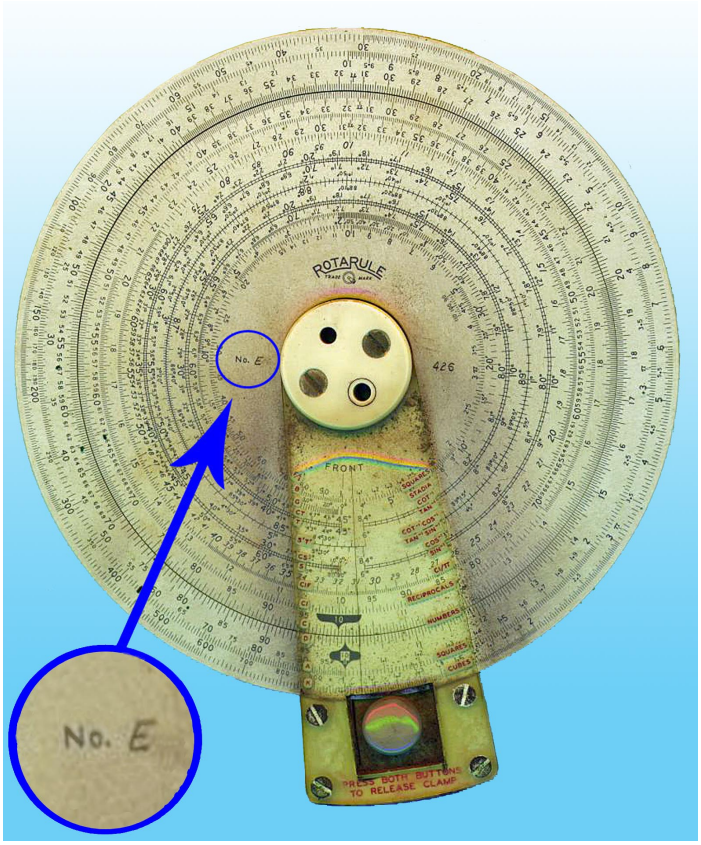


FIGURE 5.
RotaRule model "No. E" – possible transition model

The Dempster Shop [8]

To protect from fire and explosion John constructed a small boiler room in his basement using concrete for the floor, ceiling and four walls. The boiler was a gas-fired unit used to create steam. Next John designed and built a very unique water and steam operated press to make the body of the slide rule. See Figure 6 for a photo of the press showing the pressure piston below the large steel plate and the die holders above the steel plate. Upper and lower dies were used to form a disk and a ring as one piece of Vinylite. The dies had raised numbers and scale marks that formed depressions on the faces of the Vinylite. The press had steam pipes to heat both the upper and lower dies. Color-coded wax temperature test pellets were set on the rim of the die to confirm that the temperature was right when the correct pellet melted. The lower piston was hydraulically operated by Berkeley city water pressure and included a booster cylinder, also operated by city water pressure. Valving allowed most of the distance moved (approximately 4 to 6 inches) to be from city water flowing into the main cylinder, but to apply final pressure, the valves were switched so that the main cylinder was pressurized from the booster cylinder which in turn was pressurized by city water.

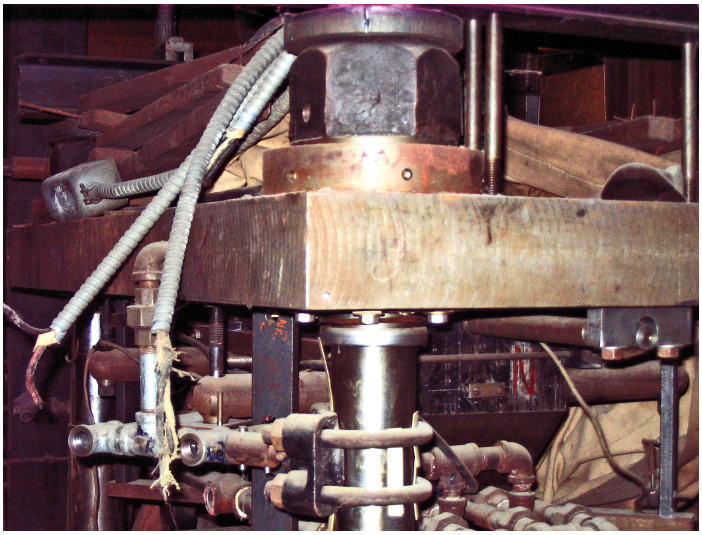


FIGURE 6.
Water and steam operated RotaRule press

The granules of Vinylite were measured out at room temperature and placed onto the face of the lower die. The lower die had a rim around it so that granules would not spill off the edges. The lower die was mounted on the top of the press' piston, which was raised hydraulically as described above. The Vinylite was then compressed and melted between the steam heated lower and upper dies. A slight excess of Vinylite resulted in some thin flares of plastic squeezing out beyond the edges, which were trimmed off when the molded piece was taken out of the press.[9]

RotaRule Manufacturing [9]

From each molding either the disk or the ring was cut on a lathe, which meant the opposite piece was discarded since some of its material had been cut away in order to access the edge to cut the correct grooves - so it took two moldings to make one RotaRule. The lathe work was a high precision operation and some variations were inevitable so that disks and rings had to be individually mated to be sure they fit and had corresponding alignment around the whole circle without discernible misalignment of the scale markings.

The edge grooves provided for steel "shoes" between the disk and ring so that the friction would be that of dissimilar materials and result in smoother sliding than would be the case if it were plastic on plastic. A light mineral oil was used to help attain smooth sliding. Tiny screws in the edge allowed adjustment of the shoes to set the friction and get exact centering of the disk in the ring.

Ink was painted over the entire faces and then wiped off, leaving ink only in the molded depressions corresponding to the numbers and scale marks. Anna often carefully performed this complex task. She also cut and sewed the optional leather cases.[8]

The arms (or cursors) and the brake assemblies were made by an outside company. The cursors were made of a clear plastic with silk screened numbers and letters.

The magnifier and magnifier stand combination was an optional accessory and both were made by an outside company. Figure 7 shows a Dempster RotaRule with magnifier. Figure 8 shows the optional leather case containing a RotaRule, with magnifier in the accessory pocket.

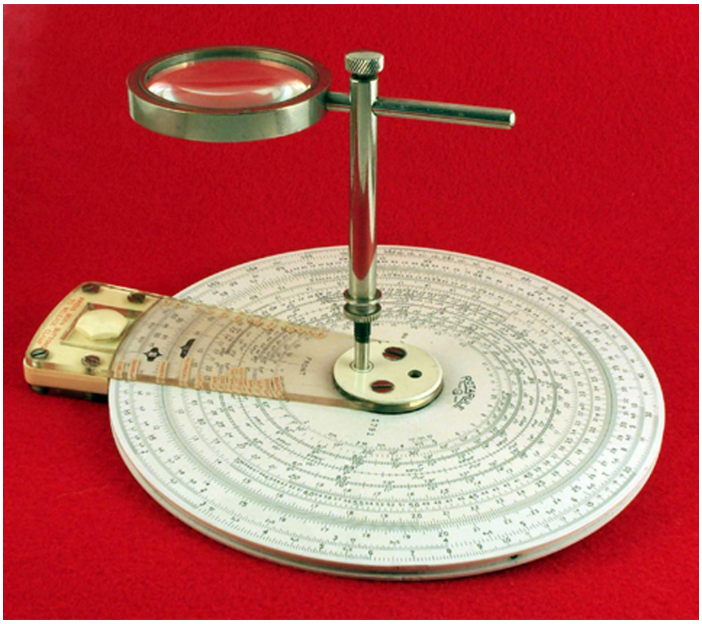


FIGURE 7.
Magnifier mounted on a RotaRule

FIGURE 8.
Leather case with RotaRule and magnifier in accessory pouch

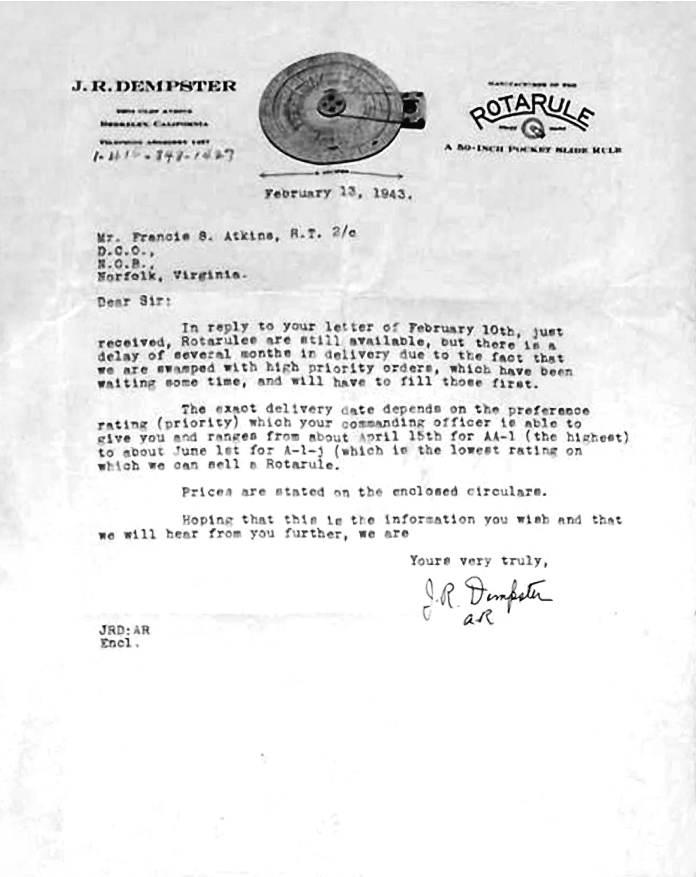
RotaRule History

John produced approximately 2500 [8] RotaRules from his home between 1928 and 1949/50. Sometime during this time he had at least one full time employee, Bill Ramsey10 - a machinist, helping him – plus members of the Dempster family. He marketed RotaRules through retailers, college bookstores and the Dietzgen catalog. The Dietzgen RotaRules were listed as #1798. Dietzgen catalog prices are listed in Table 2.

TABLE 2.
List of Dietzgen RotaRule prices

Catalog Year	RotaRule #1798	Leather Case #1798C	Magnifier #1798M
1936	$15.00	$1.00	$2.50
1937			
1938	$18.00	$1.25	$3.00
1939	$18.00	$1.25	$3.00
1940			
1941	$21.00		
1942			
1943			
1944			
1945			
1946			
1947			
1948	$32.50	$2.00	$4.00
1949	$32.50	$2.00	$4.00
1950	$32.50	$2.00	$4.00
1951	NONE	NONE	NONE

During World War II many of his RotaRules were used by the military in various applications, including gunnery calculations. One known example: a RotaRule was carried across Omaha beach during the Normandy invasion in 1945 by a young gunnery officer [9]. In addition, a 1943 book [10] by the United States Armed Forces Institute shows a RotaRule photograph.



J. R. DEMPSTER

ROTARULE

A 50-INCH POCKET SLIDE RULE

February 13, 1943.

Mr. Francis S. Atkins, R.T. 2/c
D.C.O.,
N.O.B.,
Norfolk, Virginia.

Dear Sir:

In reply to your letter of February 10th, just received, Rotarules are still available, but there is a delay of several months in delivery due to the fact that we are swamped with high priority orders, which have been waiting some time, and will have to fill those first.

The exact delivery date depends on the preference rating (priority) which your commanding officer is able to give you and ranges from about April 15th for AA-1 (the highest) to about June 1st for A-1-j (which is the lowest rating on which we can sell a Rotarule.

Prices are stated on the enclosed circulars.

Hoping that this is the information you wish and that we will hear from you further, we are

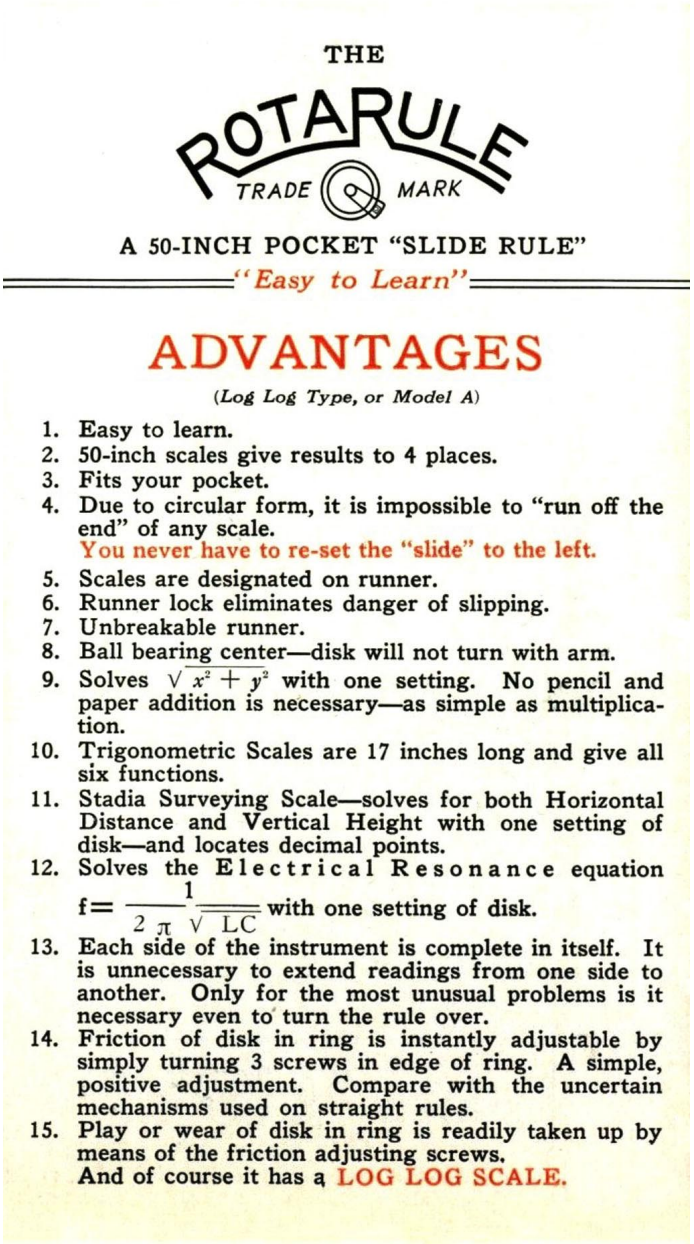
Yours very truly,

J. R. Dempster
aR

JRD:AR
Encl.

FIGURE 9.
Wartime customer letter showing usage by the military and RotaRule backlog

"During World War II wartime production needs mandated large budget deficits and an accommodative monetary policy. The outbreak of inflation and a runaway wage-price spiral was seen as a very real possibility. In 1942, President Roosevelt issued a General Maximum Price Regulation, followed a year later by a "Hold the Line Order" which froze prices …"[11]. John's wholesale price to Dietzgen was frozen. Although demand for his RotaRules outpaced supply, John found he was losing money. Unfortunately for John, President Truman determined that there were good overall reasons for price controls even after WWII; otherwise severe inflation would have set in due to the scarcity of consumer goods and the pent-up desire for them. Truman extended price controls and did not remove them until the end of 1946 or early 1947. This spelled disaster for John's business. He no longer had the capital needed to adapt his handmade manufacturing process to a lower cost process to compete successfully with K&E, Pickett, Dietzgen and others. Faced with expiring patents, unable to scale up his handmade precision process or to sell the business, and unwilling to compromise quality, John ceased RotaRule production sometime in 1948/49/50.[10,11] His RotaRule last appeared in the 1950 Dietzgen Catalog 22D and in the February 15, 1950 Dietzgen price list [12]. The 1951 and 1952 Dietzgen catalogs do not list John's RotaRule.



THE ROTARULE TRADE MARK

A 50-INCH POCKET "SLIDE RULE"

"Easy to Learn"

ADVANTAGES

(Log Log Type, or Model A)

1. Easy to learn.
2. 50-inch scales give results to 4 places.
3. Fits your pocket.
4. Due to circular form, it is impossible to "run off the end" of any scale.
   You never have to re-set the "slide" to the left.
5. Scales are designated on runner.
6. Runner lock eliminates danger of slipping.
7. Unbreakable runner.
8. Ball bearing center—disk will not turn with arm.
9. Solves $\sqrt{x^2 + y^2}$ with one setting. No pencil and paper addition is necessary—as simple as multiplication.
10. Trigonometric Scales are 17 inches long and give all six functions.
11. Stadia Surveying Scale—solves for both Horizontal Distance and Vertical Height with one setting of disk—and locates decimal points.
12. Solves the Electrical Resonance equation $f = \frac{1}{2\pi\sqrt{LC}}$ with one setting of disk.
13. Each side of the instrument is complete in itself. It is unnecessary to extend readings from one side to another. Only for the most unusual problems is it necessary even to turn the rule over.
14. Friction of disk in ring is instantly adjustable by simply turning 3 screws in edge of ring. A simple, positive adjustment. Compare with the uncertain mechanisms used on straight rules.
15. Play or wear of disk in ring is readily taken up by means of the friction adjusting screws.
    And of course it has a LOG LOG SCALE.

FIGURE 10.
Page from RotaRule brochure circa 1928-1929. Although the brochure bears no date, the RotaRule model pictured elsewhere in the brochure has 5 black spots surrounding its center, a characteristic of the early Model A from 1928-1929.

Acknowledgements

Much of the new material in this article was supplied by members of the Dempster family. Without their memories and photographs of John and his RotaRule, this paper would not have been possible. Special thanks go to Bill Dempster for his descriptions of the shop and manufacturing process, to Doug Dempster for supplying much of the family genealogy and other history and to Janet Dempster for an insight into

her father's life. Stuart Dempster helped to steer my research efforts in the right direction. Dick Rose, Katherine Matthews, Bob Otnes and Bruce Babcock helped with RotaRule pricing history from the various Dietzgen Catalogs. Fred Koehn helped with some of the photo restoration. I would like to thank Rodger Shepherd for reviewing the paper and making several helpful suggestions.

Due to dealing with events which occurred over 80 years ago, the author wishes to acknowledge that certain inferences and conclusions have been made and any errors that may have been made are unintentional. The author would be pleased to have additional serial numbers of known RotaRules for Table 1 and Dietzgen prices for Table 2.

Footnotes

1. Dempster, Doug, private communication, August 21, 2009.
2. Dempster, Doug, *Ten Generations of Dempsters*. December , 1985.
3. Dempster, Doug, private communication, August 21, 2009.
4. Dempster, Janet, telephone communication, September 4, 2009.
5. Dempster, J.R., Circular Slide rule, United States Patent US 1,849,058 1932 March 15.
6. Dempster, J.R., Disk Slide rule, United States Patent US 1,868,058 1932 July 26.
7. Dempster, Janet, telephone communication, August 25, 2009
8. Dempster, Bill, private communication, August 15, 2009.
9. Dempster, Bill, private communication, August 18, 2009. Note: Bill remembers at age 8 helping his Dad run the hydraulic press to make RotaRules – probably in 1948/49.
10. Dempster, Bill, private communication, August 26, 2009.
11. Dempster, Janet, telephone communication August 23, 2009.

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2. Hughes, Richard Smith, *John R. Dempster's RotaRule Model AA; A Masterpiece in the Art of Slide Rule Design*, Journal of the Oughtred Society, 16:1, 2007.
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