

J.- F.- B. CHARRIÈRE: THE MAN BEHIND THE "FRENCH" GAUGE

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□ **Abstract**—**Joseph-Frédéric-Benoît Charrière, a 19th century Parisian maker of surgical instruments, has by virtue of his ingenuity and advanced thinking, continued to have his presence felt in medicine throughout the 20th century. His most significant accomplishment was the development of a uniform, standard gauge specifically designed for use in medical equipment such as catheters and probes. Unlike the gauge system adopted by the British for measurement of needles and intravenous catheters, Charrière's system has uniform increments between gauge sizes (1/3 of a millimeter), is easily calculated in terms of its metric equivalent, and has no arbitrary upper end point. Today, in the United States, this system is commonly referred to as French (Fr) sizing. In addition to the development of the French gauge, Charrière made significant advances in ether administration, urologic, and other surgical instruments, and the development of the modern syringe.**

□ **Keywords**—**Charrière; French gauge; medical equipment; surgical equipment; ether anesthesia; urology**

In the first half of the 19th century, the British, in the throes of the industrial revolution, were still trying to adapt an arbitrary sizing system (the Stub's Gauge which was adapted to the manufacture of needles and catheters only in the 20th century) in order to standardize their manu-

facture of metal wires.¹ Meanwhile, the French had developed a uniform, standard gauge based on the metric system. This gauge was specifically designed for use in medical equipment, such as catheters and probes. The famous Parisian maker of surgical instruments, Joseph-Frédéric-Benoît Charrière (Figure 1), developed this measurement system. Today, in the United States, this system is commonly referred to as French (Fr) sizing.

Charrière was born in 1803 in Cerniat in Gruyere, Fribourg Canton, Switzerland. At the age of 13, he was sent to Paris and apprenticed as a cutler (a maker of cutting instruments, such as knives). Four years later he became both a master cutler and the owner of his own business after the untimely and mysterious drowning of his former teacher, whose business he acquired. Charrière quickly developed a reputation among Paris surgeons as a skilled and innovative maker of surgical instruments. Part of this reputation stemmed from an incident that occurred shortly after he opened his business.

Charrière was hammering the metal and sharpening the lancets and knives, when into his boutique flew a young man. By his white apron, his fine featured and intelligent face, and by his distinguished build he could recog-

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Figure 1. Joseph-Frédéric-Benoît Charrière (1803–1876). (Print courtesy of The New York Academy of Medicine Library.)

nize this man as an intern at the Parisian hospitals who was urgently sent by the departmental head to ask advice of the humble cutler. It was an urgent case, a poor soul who was brought to the Hotel-Dieu, choking and groaning due to a coin that he had swallowed. It was lodged in the esophagus and was compressing the larynx. Charrière, without even removing his apron, hastened to follow the young man, taking with him a Graefe's hook. The ingenious instrument, under his timid direction, was used with great success; the patient was saved. Dupuytren was the departmental head.²

Charrière thereafter became Dupuytren's private supplier of surgical instruments. They worked together developing, testing, and utilizing new designs for older surgical instruments as well as for innovations. Charrière was described as being affable, hard-working, and very much a perfectionist. He not only developed the instruments, but observed their use both in cadaver experiments and during sur-

gery. However, due to the very short duration of operations (even under ether anesthesia, 4 1/2 minutes was considered a long procedure), his observations had to be quick.³ These observations allowed him to see how well his instruments worked in actual practice, thus enabling him to develop new modifications quickly. One of his guiding principles (Table 1) was "Given an unusual, extraordinary or unexpected case, immediately create an instrument capable of serving the situation."²

By 1825, four years after obtaining the business, Charrière was supplying the instruments for twenty famous Parisian surgeons, and his reputation continued to grow. However, no matter the quality of his wares, the surgical community, in general, felt that Parisian-manufactured goods should be used only if British equipment, especially knives from London or Sheffield, could not be obtained.

In 1837, Charrière visited England to see the English manufacturing methods first hand. "Upon his return to Paris, he visited several of our famous surgeons and told them:

'Here, as you requested, I have purchased for you the scalpels made in London.' The professional man examines them, raptures over their beauty, their grace, their excellent cutting edge, and proclaims: 'Finally! This is what we need. You, the French workers, you are incapable of making us these little gems.' Without saying a word, Charrière opened the instrument case; one reads *Charrière*. The scalpels had been forged, tempered, and sharpened in Paris, by his workers.²

This was the beginning of the worldwide Charrière reputation for excellence in the manufacture of surgical instruments, which would last into the 20th century.⁴

Charrière produced a wide variety of innovations in surgical instruments. He developed fine surgical scissors that operated without a screw to fasten the blades. This allowed the scissors to be disassembled for cleaning and reassembled in only a few seconds. He developed the

Table 1. Charrière's Guiding Principles

1. Simplification of the surgical instrument.
2. To unite in the same object—compactness, elegance, and solidity.
3. Reduce prices as much as possible to make instruments available, as much as possible, to all practitioners.
4. Never to back away from any experiment or expense that would make him the interpreter of the surgeon's imaginative innovation.
5. Diminish size of instrument while rendering it more suited to all uses.
6. Closely observe actual use of these instruments—on cadaver experiments or at surgery.
7. Given an unusual, extraordinary, or unexpected case, immediately create an instrument capable of serving the situation.
8. Investigate foreign manufacture; borrow that which is of use and succeed at doing it better.
9. Furnish an arsenal of surgical supplies that could fill all of the needs, without being cumbersome, to all large users.²

forerunner of the modern hemostat that “were made capable of exerting a continuous pressure without the surgeon’s constant application (of force) by the addition of a small system of notches.”² In addition, he developed a nonbreathing system for giving ether anesthesia at a time French surgeons were highly skeptical of “the new American invention.”³ His administration device allowed administration of ether in a controlled, and much more effective manner than had previously been available. The result was that ether anesthesia became an accepted modality, even by previous skeptics.

Charrière also developed the use of several new materials with which to manufacture surgical instruments. These included flexible ivory, in which the inorganic materials had been removed to make the ivory less rigid. He also began using nickel silver, originally developed by the English, to replace the more rigid nickel, and used tempered steel to replace iron.

Charrière also made significant improvements in the medical syringe. Although not in as common use as in current medical practice, the syringe was used to aspirate, inject a liquid, or to irrigate. However, using the syringes commonly available required a great amount of strength to move the plungers that were made of stiff leather. Charrière’s improvement was to develop a “double-parachuted piston,” otherwise known as a “double diaphragm, double valve” that allowed an

efficient and less rigid movement of the syringe plunger.

One of the most innovative areas in which Charrière was involved was that of the design and manufacture of urologic equipment. He developed the lithometer, used for measuring the size of bladder calculi and several types of lithotripsy forceps used to crush urethral and bladder stones. These instruments were in wide demand not only in France, but all of Europe. However, the surgeons purchasing the tools needed to know exactly what sizes they were ordering.

In 1842, Charrière invented the system recognized today in the United States as French sizes, which was based on 1/3 of a millimeter (Table 2). Unlike the gauge system adopted by the British for measurement of needles and intravenous catheters, Charrière’s system has uniform increments between gauge sizes, is easily calculated in terms of its metric equivalent, and has no arbitrary upper end point. The system is used today both for urologic equipment, including urethral catheters, and for large intravenous lines.

During his lifetime, Charrière’s system of measurement allowed him to refine his quality control on equipment manufacture and to develop a brisk trade and thriving business throughout Europe. For his achievements, Charrière, who had only become a French citizen in 1841, was named to the Legion of Honor in 1843. In addition, numerous national and interna-

Table 2. The French Gauge System—Comparison With the Metric and Stub's Gauge Systems

| Gauge No. | Inch | French* | mm |
|-----------|--------|---------|--------|
| 36 | 0.0040 | 0.305 | 0.102 |
| 28 | 0.0140 | 1.067 | 0.356 |
| 23 | 0.0250 | 1.905 | 0.635 |
| 19 | 0.0420 | 3.200 | 1.067 |
| 16 | 0.0650 | 4.953 | 1.651 |
| 10 | 0.1340 | 10.211 | 3.404 |
| 8 | 0.1650 | 12.573 | 4.191 |
| | | 14.000 | 4.667 |
| | | 16.000 | 5.333 |
| | | 18.000 | 6.000 |
| | | 20.000 | 6.667 |
| | | 22.000 | 7.333 |
| | | 24.000 | 8.000 |
| | | 36.000 | 12.000 |

*Although the French gauge system is based on three times the measurement in millimeters, some of the numbers appear to be other than exactly three times the millimeter equivalent due to rounding (adapted from Reference 1).

tional awards were bestowed upon him. However, due to the early deaths of both of his sons, who were his heir apparents, he worked up to the end of his life. Charrière died in 1876, leaving both his business and his legacy to two of his former pupils.

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