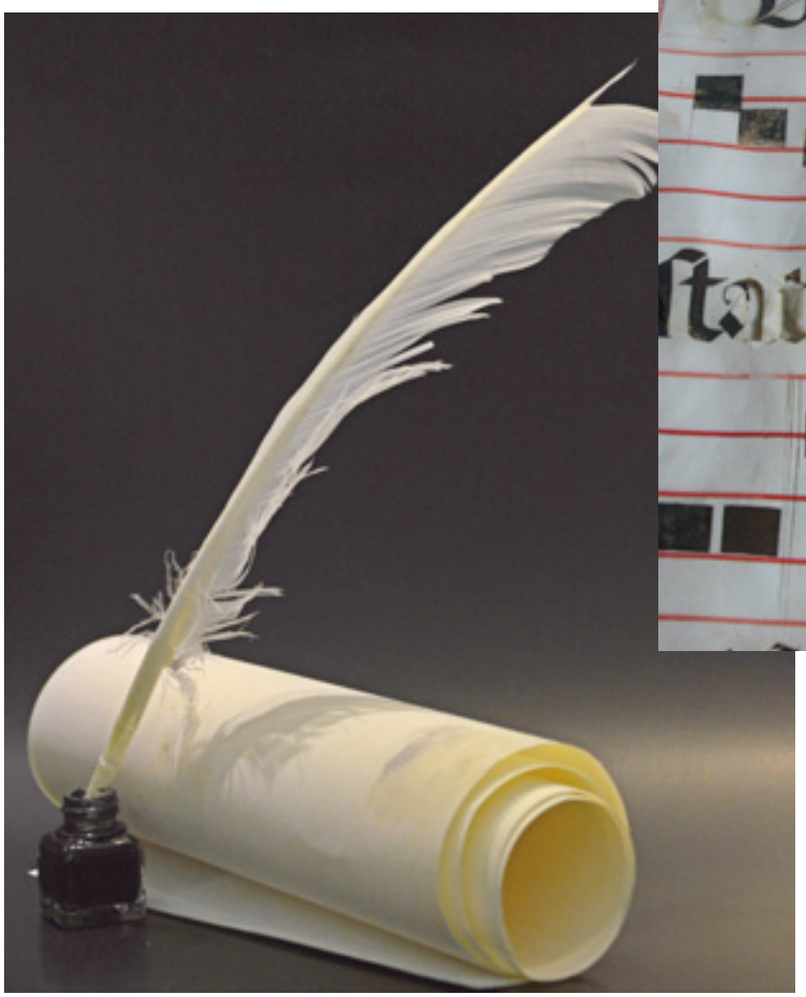
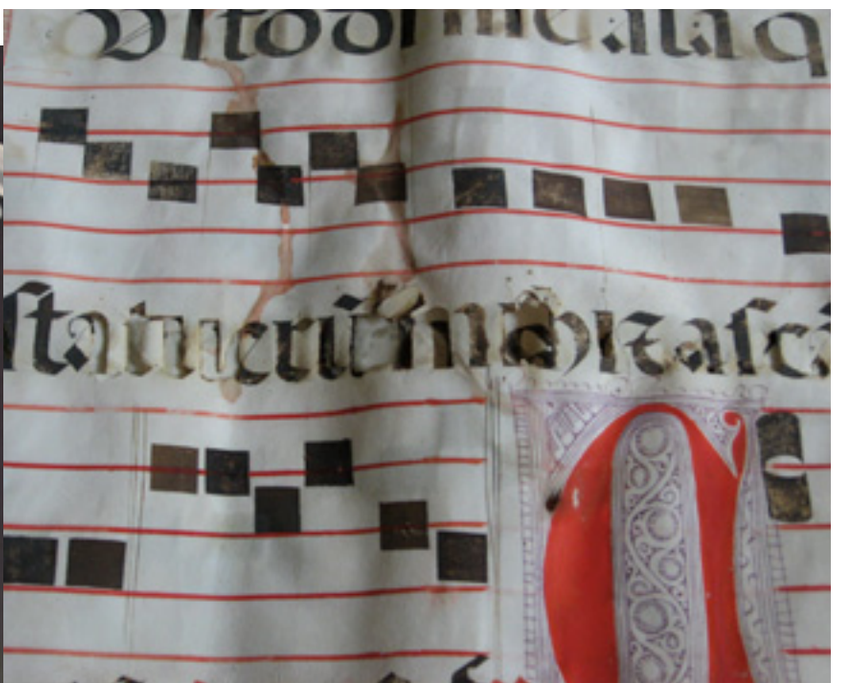
In this class, students explore the basics of fountain pen ink chemistry. Three credits.

Inkology 101

BY REINHARD KARGL





Manuscript from Igreja de Sao Francisco, Evora, Portugal shows erosion as a result of iron gall ink. Photo courtesy Ceinturio. Quills and reeds were the styli of choice for centuries. Photo courtesy Mushki Brichta.

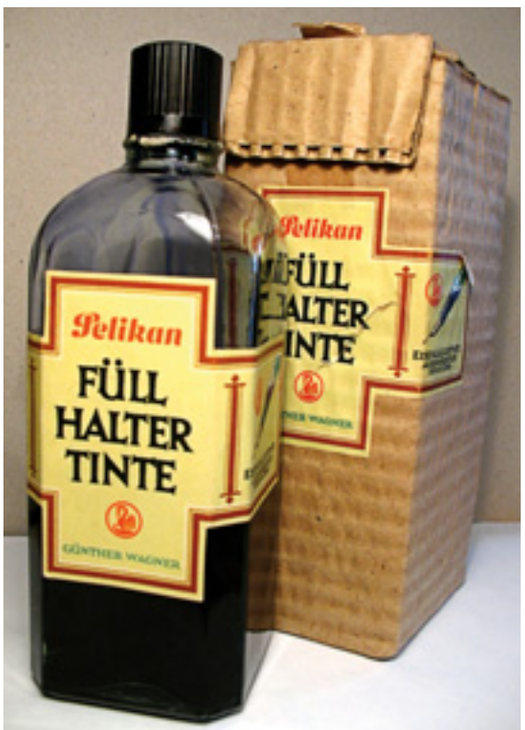
For 3,000 years, writing inks have been applied with brushes, reeds, bird feathers, or metal nibs; but the arrival of fountain pens in the 19th and 20th centuries necessitated the development of new inks.

Pigments (such as carbon soot) and binders (such as shellac) used in much older inks would inhibit the capillary action taking place in fountain pens. As Sam Fiorella of Pendemonium explained at one of her pen show seminars: "Fountain pen ink is dye based, not pigment based. Drawing inks, Japanese sumi, and calligraphy inks would gum up the pen. And, fountain pen ink is water based, not oil based like printing ink."

A legendary ink formulation called iron gall dominated European writing for well over 1,400 years, and we will cover it in detail in a future issue. Its unique chemistry makes it indelible, but the products of its reaction with oxygen tend to clog fountain pens. Further, the corrosiveness of such ink formulations spelled trouble for long-term storage in fountain pen reservoirs. Highly durable, the traditional inks were (and are) great for dip pens and brushes but not ideal for fountain pens; they are finicky eaters, and one downside is that what the fountain pen likes is also less durable.

So what does modern fountain pen ink consist of? Are you ready for a little chemistry?

First there's the "vehicle": water, polymeric resins, compounds that react with the cellulose in paper, and humectants (to prevent premature drying). The surface tension of distilled water is too high to flow through the

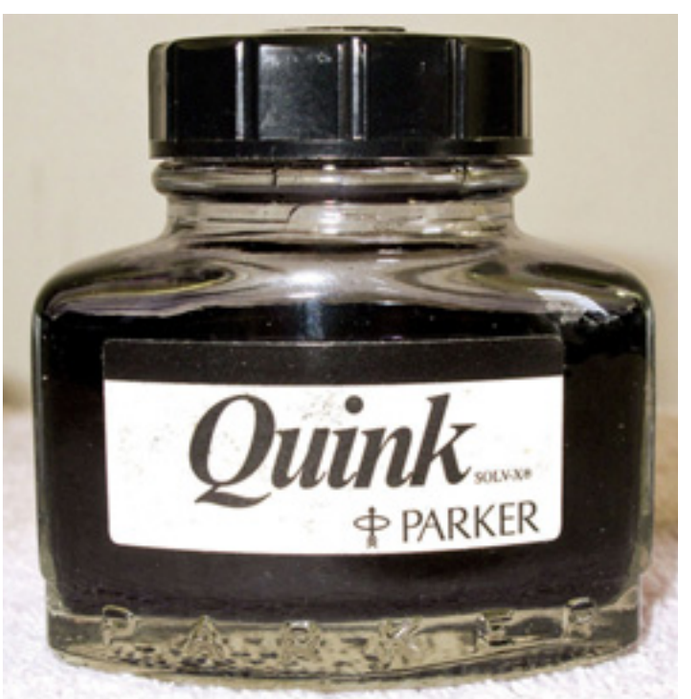


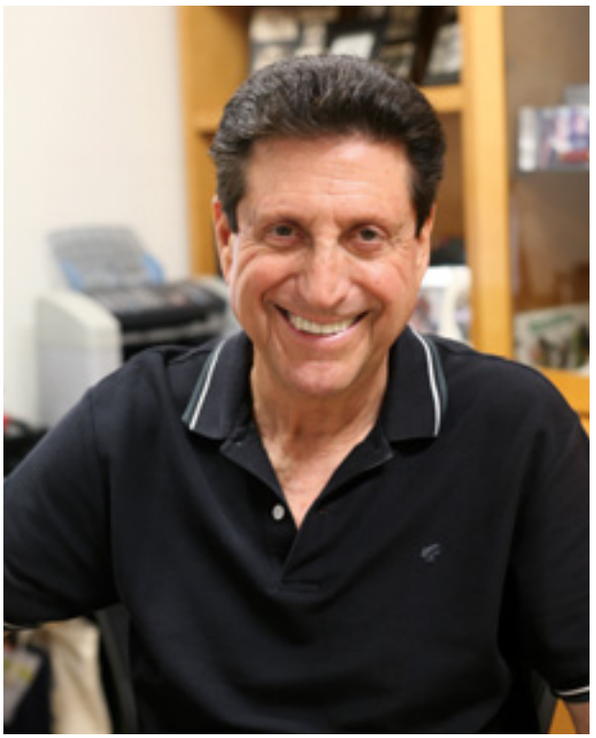
Vntage ink, from left—Vintage Pelikan blue-black with box, Ulma fountain pen ink concentrate, Pelikan blue-black fountain pen ink, Pelikan "Brillant Rot" (bright red) fountain pen ink, and Pelikan permanent black drawing ink.
Below—vintage Parker Quink black ink.

pen, so it is reduced by surfactants (essentially detergents). Too little of that, and the ink won't flow, but too much of it, and the writing would become too wet. And it could froth (which can be counteracted by an anti-foaming agent). The chemistry also affects an ink's tendency to be absorbed into paper: more absorbability increases feathering and ghosting, but less of it delays the drying time. Organic compounds could result in bacterial or fungal growth, so biocides (essentially preservatives) are added. Although some fountain pen inks may contain small amounts of solid pigments, the main color comes from soluble dyes, such as triarylmethane for blue, or eosin for red.

The use of dissolved dyes instead of insoluble, solid-but-suspended pigment brings with it another problem, as the color of many dyes depends on specific acidity or alkalinity. The latter is measured as the pH level on a scale from 0 to 14. I'll spare you the exact scientific definition; it is complex and of no consequence for the following. But we should note that the lower the pH value, the more acidic a liquid is. The opposite of an acid is called a base, and the higher the pH value, the more alkaline the liquid is. The median between acid and base is distilled water (pH 7). Modern fountain pen ink shows an astonishing range, from highly acidic at pH 1.5 to very alkaline at almost pH 10!

Here lies a conundrum for both ink makers and ink users. The manufacturer must create a pH level to bring out the desired color. But the user is faced with the problem that ink is usually not labeled for pH. Acid is corrosive to many materials, especially metals. Before corrosion-resistant steels could be shaped into nibs, the remedy to this problem was nibs made from gold, which is non-reactive and therefore immune to acid. On the opposite end of the scale, high alkalinity can damage resins, celluloid, ink sacs (especially those made of latex), and other parts.





Monteverde head Yair Greenberg is expanding the company's ink offerings, recognizing the building demand for new and better fountain pen ink colors.

If all this chemistry intrigues your inner chemist, you may be drawn to mixing inks. (I know I am). But this gets very tricky. Combining inks of different pH levels may cause unforeseen color changes and even a loss of color. And some dyes may coagulate or precipitate if the concentration of the specific dye's solvent changes. If this doesn't deter you, it would be highly advisable to determine the pH level of each ink and mix only with inks of similar values. Conduct your experiments in a petri dish, carefully observe what happens, and do not risk your most prized vintage or expensive pen. Want to play it safe? Platinum sells bottled mixable ink and an ink mixing kit, and Pilot has mixable ink in cartridges.

Here are some other safety tips: rinse your pen before changing from one ink to another. When in doubt, the pen manufacturer's own ink is most likely the safest bet. For instance, Japanese inks like Pilot's Iroshizuku tend to be very alkaline. While it is safe to assume that Pilot pens do not contain materials damaged by this alkalinity, you may want to avoid this ink in valuable vintage pens. By the same token, it is not a given that Pilot pens would be equally happy with very acidic inks. By knowing the pH level of the pen manufacturer's own (or recommended) ink, you could try to find other ink in a similar range. Or, you could choose an ink in the neutral range.

Decades ago, most fountain pen ink sold was black or blue. These were the easiest dyes to get to at least a level of permanence acceptable for most applications without clogging the pen. Red was available for special purposes. Today, ink makers are offering and developing inks in every imaginable color, hue, and sheen, different levels of viscosity and wetness, and different degrees of permanence. Some of these manufacturers are brand new. But many well-known English, German, and Italian ink makers were well established in the 1800s, and Herbin of France dates back to the 17th century.

Yet others, like California's Monteverde, follow a middle ground. Monteverde goes through great creative effort to curate inks, then contracts with European laboratories and specialty suppliers for inks made to exact specifications, to which it adds proprietary improvements. To date, the company offers 33 different inks and plans to expand to 50 by the end of the year.

Every bottle of ink contains letters, words, and sentences not yet formed and separated—writing that will be, some time in the future. All we have to do is infuse the liquid with our imagination, spread it out, and let it dry. The pen is just an ink applicator.

Read more of Reinhard Kargl's work at reinhardkargl.com, and join the author as he visits the Monteverde factory in the upcoming December 2017 issue of PW.

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In a series of architectural sketches, Mexican artist Jose Manuel Sandoval displays the artistic heights this pen can reach.

See more of these sketches and learn more about the Monteverde USA Tool Pen's new finishes in the October special edition 30th Anniversary issue of *Pen World*, featuring our 25th Annual Fall Preview of Pens.