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TECH

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TECH TOOLKIT

The Rolling Mill: A Jewelry Studio's "Forever Tool"

STUDIO VIEWS

Bench Tricks for Jewelers

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• **Curtis H. Arima,** *Heartfelt: Bleeding Heart* (see p.20)
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Forging on the River. Sorting parts, left to right: Elizabeth Belz, Lewis Meyer, Karine Maynard. Photo: Kim Ward

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STUDIO VIEWS

Bench Tricks for Jewelers

BY CHARLES LEWTON-BRAIN

WHAT IS A BENCH TRICK? A shortcut? A faster way of doing something? A better method? A tool made for one purpose used for another? A tool or technique that saves time, effort, thought, and work?

A bench trick is a door to insight. It has to do with that emotional reaction: a reset moment, a flash of enlightenment! Pay attention when you have this reaction, and you will learn…

This article is about bench tricks and thought: the kind of problem-solving that is useful in the jewelry workshop for solving technical, tool, and procedural problems, whether a specific issue or the lack of a necessary tool. In this article we glance at the role of process and procedure in jewelrymaking. We will also look at several specific bench tricks as examples of how jewelers have problemsolved successfully.

Bench tricks are keys to understanding process, and are therefore useful to understanding the nature of metal and metalworking. Bench tricks are created by recognizing patterns around you, as well as working to invent new tricks and solutions to problems.

PROCESS VS. PROCEDURE

There is a fundamental difference between process and procedure. Process in this context may be understood as what really happens when one works in metal. A procedure, on the other hand, is just a way of executing a process; it is a formula or a technique.

If one knows only formulas and procedures, then one can be shut down by a technical problem when working. However, if one looks to the process, one can come to solve technical problems relatively easily. Engineers, doctors, and scientists are supposedly taught in terms of process so they become able to solve technical problems. But our educational system for metalworking seems to be full of procedures that are taught the "right way," rather than as being on a spectrum of technical approaches to an end result. This is, for the most part, true for both industry and art-school approaches to educating metalsmiths. There may be dozens of procedures to obtain a similar end effect, but there will be only one process or series of processes occurring.

Bench tricks are keys to understanding process, and are therefore useful to understanding the nature of metal and metalworking.

Methods of Metalworking

There are only three ways that metal is actually worked, in terms of process: chemical (including solders and alloys), heat, and mechanical interactions. Mechanical interactions can be divided into two major categories: mechanical deformation, which utilizes the metal's capacity to flow; and chip forming, or tearing chunks off of the metal in different ways.

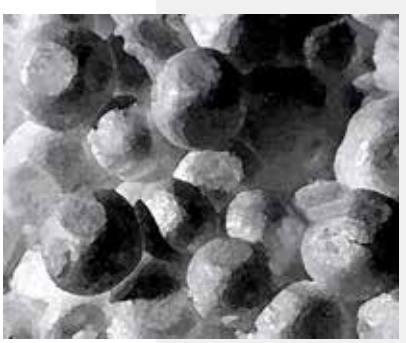
CHEMICAL

We work with metals both as chemicals and in ways involving chemicals. Metals are dissolved chemically, becoming solutions, and may be plated back as solids from solution. Metals may also be combined with oxygen (oxidized) and other chemicals in various forms of corrosion including firescale, rust, patina, and so on. Alloys are a kind of chemical mixture, usually of metals but sometimes including other kinds of materials. Solders are in this category, as they are alloys designed to melt at lower temperatures than the parent metals to be joined.

HEAT

We treat metals with heat, which expands, contracts, and changes metals' crystal structure. We can bring alloys to a "pasty state," that is, a mixture of solid and molten particles, like a porridge. We can make metal fluid and pour it as a liquid into a mold that allows it to solidify into shapes when it cools. With the application of heat, chemical reactions happen that do not occur at room temperature. Heat accelerates chemical reactions of all kinds. We can anneal metal to realign its crystal structure, making it soft after work hardening. Alloys can be made harder by heating, migrating harder copper oxides to the grain boundaries of the crystals. Metal crystals look sort of like grapes that have packed too tightly in a crate: they have facets on them where they bumped into each other while forming.

The grain boundary is the "skin" of the grape. This 3D mesh of harder skin stiffens the metal, increasing hardness by large percentages, up to 200 times harder than annealed metal.



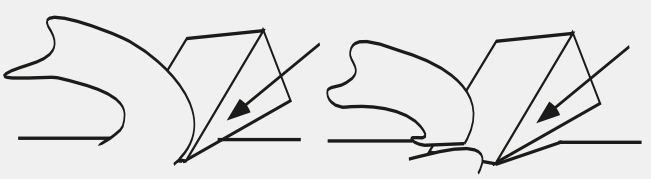
For example, sterling can be heat-hardened (or age-hardened) in a household oven for several hours at 450F to harden it (you might want to wrap it in copper foil to avoid firescale), and 18k gold, for example, can be significantly hardened in just an hour.

MECHANICAL DEFORMATION

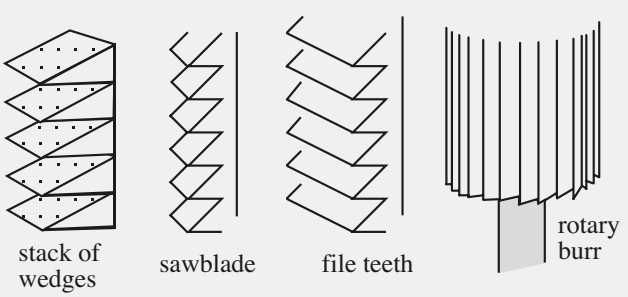
Metal actually works very much like clay. Ductility is used extensively by blacksmiths, chasers, and people who roll, draw, forge, and set stones in metal. Metal is a mobile, fluid, ductile, pliable material. You can stretch it like toffee or thicken a sheet by planishing just as you would push a slab of clay around with your fingers. You mush it around, treat it as supremely plastic stuff. I once had a student with twenty years of experience as a stonesetter take a workshop with me. I saw him again several years later and asked if anything from the class had been useful. He said "Yes! The idea of metal as clay. My stonesetting improved two hundred percent!"

CHIP FORMING

Chip forming, that is, tearing chunks of metal off in a subtractive manner, comprises everything else that goldsmiths do to metal. Here is a diagram of how a wedge drives into a metal surface, raising and finally separating a "chip."



A graver or chisel is clearly a wedge. A file is a stack of single flat graver teeth (wedges); a sawblade is too; a bur is a bunch of wedges (graver teeth) wrapped around a cylinder; a drill bit is two wedges on the end of a rod and so on. All cutting and abrasive tools used by metalsmiths are based on chip forming, even polishing operations where the "wedge" is formed by sharp angles on the little jagged boulder that is a piece of abrasive grit. Pushed against the metal from different directions, different parts of the grit line up to tear chips off the metal. This goes for sandpaper, emery paper, tripoli, and other polishing compounds—even rouge: all are examples of subtractive work through chip forming.



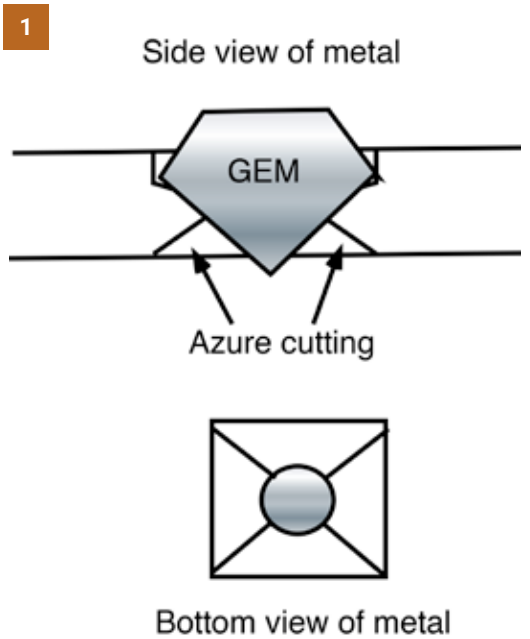
By examining the process, one is able to discover numerous procedural options. Some options will not be appropriate for one reason or another, and it is the maker's responsibility to make a good technical decision. However, by thinking of as many solutions as possible, one learns about the material quickly and more easily.

For instance, instead of "cutting with a jewelers' saw," think of the issue as "separating sheet metal." Then list all the methods available, which includes all kinds of shears, lasers, chisels, etching, bending back and forth, abrasive cutting, engraving, using a nibbler, shaped explosives, and of course, using a jewelers' saw. And you *will* probably use the jewelers' saw for your task. But down the road, one of the other procedures may be the right answer. A useful jeweler's exercise is to think of at least five different procedures for any given end result. It is good for your practice to make a habit of this kind of thinking. There is no "right" way to do things, merely variations of suitability to the technical problem at hand.

CONTRAST & COMPARISON

One principle of developing bench tricks is that if something looks like something else, it is. For instance, thinking of a sawblade as a thin file, or a file as a fat sawblade, allows you to understand more about each tool's possible uses. For example, there is a traditional goldsmithing technique called "azure sawing" (figure 1) in which the sawblade is used as a file to create sloping angular surfaces behind set gems.

1



Another example is to think of a hammer as a punch on a stick, and a punch as a hammer without a handle. Using contrast and comparison helps you understand a system faster and deeper. One good exercise is to place two tools next to each other and then examine what is the same and what is different about each.

There are a number of ways of finding solutions to specific problems, but here is my checklist:

PROBLEM-SOLVING CHECKLIST

1. Identify the problem and define it.
2. Examine and list alternative solutions: brainstorm.
3. Define and describe alternative solution steps and requirements: iterations.
4. Compare solutions by listing pros and cons.
5. Choose solution.
6. Plan how to put solution into action.
7. Take action and complete problem resolution.

GUIDELINES FOR DEVISING BENCH TRICKS

• **Describe the problem as clearly as you can.** For instance, if you want to build a ventilation system, the problem can be distilled to "move air fast." Describe the process that is occurring. Then look for solutions that fit the problem at hand.

• **Who else has your problem?** Look for industrial examples of your problem and possible solutions. Take that ventilation system, for example. One can assume that ordinary household products are designed by teams of people, and have parameters such as how small of a motor can be used with the maximum effect at the lowest cost. So which household objects "move air fast"? A household fan is not fast enough, nor is a kitchen vent fan, but a vacuum cleaner is. Most vacuum cleaners have a similar form: a narrow hose (this forces a higher air speed for a given motor size); a round hose (which reduces turbulence and convection issues); and a narrow, long slit to collect air (which is the most efficient way to gather air/dust from the furthest distance into the hose). Another home appliance that moves air fast is a hair dryer: most share that pistol-like shape encasing a squirrel cage blower (that is because this shape moves air fastest for that given motor size). This blower type is used for oil furnace blowers in houses for the same reason. Blacksmiths' traditional hand blowers on forges were this type too, so the smith could use less energy when working.

Therefore, for your own ventilation system, you'll want to use a small round tube to pull the air through, have a slit vent(s) where the air is gathered, and use a squirrel cage blower in the system, probably near where the air exits. Another advantage of this type of setup is that any caustic fumes do not come in contact with the motor, which is outside the blower itself.

Another example of this principle is an enamelist's need for local ventilation to remove toxic powder while sifting. They require something to suck the excess powder away as soon as it is made, a fan strong enough to do this, and a HEPA filter so that the tiniest particles are not just boosted into the air. Who has this problem? Aestheticians create acrylic dust when buffing nails, and have units that fill all these requirements. And because there are a lot more aestheticians than enamelists, these nail dust collectors are very affordable.

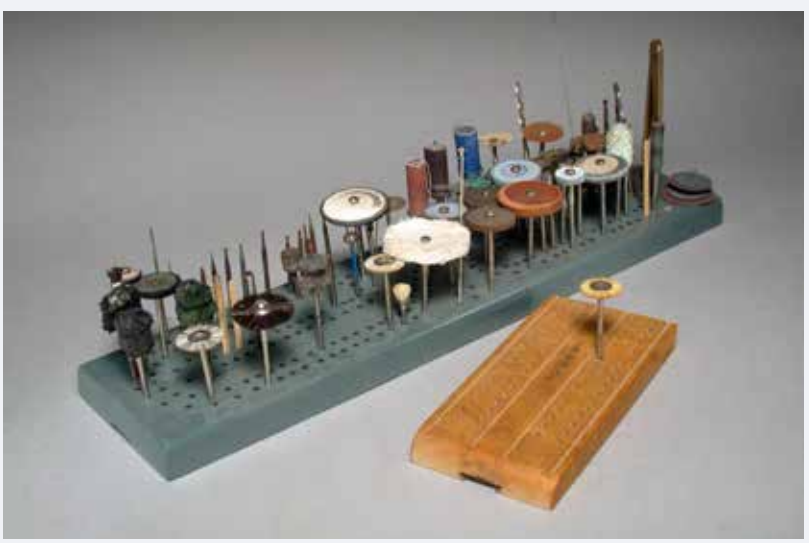
• **Can you shift categories?** It is important to "shift categories," that is, to look at how you (and other people) define things and see if you can break out of those classifications. One example is

A polishing machine has the machinists' spindle size (right), which forces you to buy expensive jewelers' buffs. If you get the one on the left from a machinist supply for a few dollars, you can now put cheap buffs onto it—and pricey jewelers' buffs.

This is an ergonomic pusher handle made from an old pipe.

➤ Trays are important in a jeweler's shop for protecting the work and isolating steps and stages.

Here a golf ball has been used as a graver handle and as a handle for stamping metal with quality marks (Axel Bernal). I have seen graver handles made with Aqua-plast and Sculpey as well.



If you don't feel like drilling all the holes to make a burr stand, look for a cribbage board at a flea market.

chasing tools, which sell as high as $15 each on eBay. Meanwhile, boxes of 80–100 watchmaker's staking tools (made of the same hardened and tempered steel, the exact same thing as chasing tools, and easily altered to suit one's purpose) sell for $45 (see figure 2). Watchmaker's tools are classed as obsolete, and only for fixing watches, but shift mental categories, and that box is worth a bundle as chasing tools. Try to categorize objects in new ways.

2

In the same way, driver bits of all kinds are cheap and can be used as metal stamps (see figure 3). This set of thirty-two security screwdriver bits is under $11, and works great for stamping. Stamps have value; driver bits do not. If you are going to use them as stamps, heat the back ends up until they turn blue, and air-cool to make sure that the part you are hitting is not brittle.

3

Another example of a category shift is ball bearings (see figure 4), which can be easily brazed (soldered) onto a steel rod to make dapping tools or onto a tack hammer to make a forming hammer. You use a ton of white paste flux and some scrap brass wire to join them. I grind a flat spot on the ball bearing to relieve stress and increase the strength of the join. Ball bearings are expensive, as much as $6 each. But if you look for "Steelies," that is, kids' steel marbles, the retail category is "toy" rather than "tool" and so has a lot less value. I have bought a full set of eighteen graduated ball bearings for $3 because they were in the "toy" category.

4

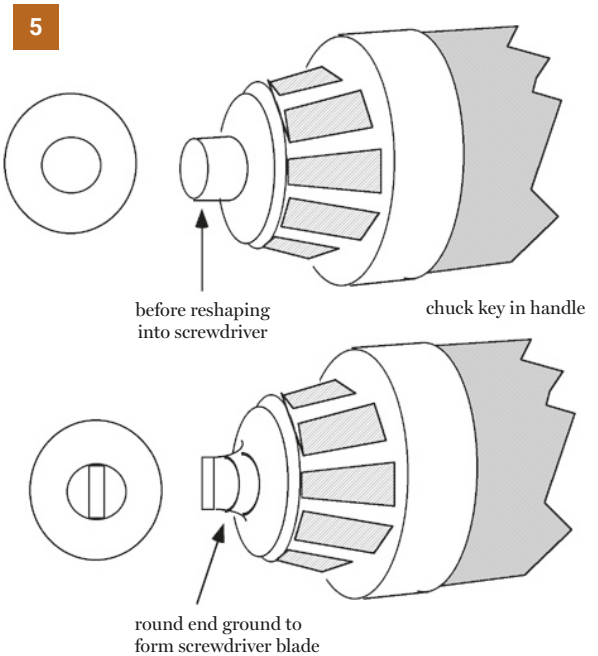
▼ This is a steel boat cleat: they come in all sizes from tiny to huge and can be used as raising stakes. The small ones can be worked to create miniature raising and shaping stakes.

• **What is the action taking place?** Is there a smarter way of using this action? Examples include putting a chuck key in a handle and cutting off the T-bar, because its use is about rotation, not cranking. Or placing your thumb on the cogs of a #30 flex shaft chuck and gently pressing the foot pedal: this rapidly closes the jaws onto the tool. Similarly, you can mount tools onto flex shaft screw mandrels by inserting the small screw into the disc, setting it into the opening in the screw mandrel, then pressing the foot pedal which instantly self-mounts the disc onto the mandrel.

• **Can you combine elements of a job into one tool?** Examples might be where I have ground the round nub of the chuck key into a screwdriver shape (see figure 5). This does not change its width so it still works like a normal one, but now your screwdriver for mounting flex shaft tools is always at hand.

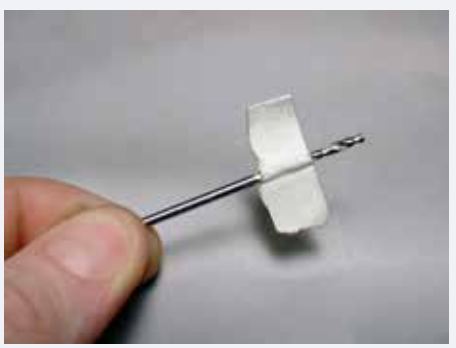
Another combination is to snap off the end of a triangular or square needle file and grind it to a fifty-five degree angle: now you have a file-graver for scoring and bending. Hold it at one

5



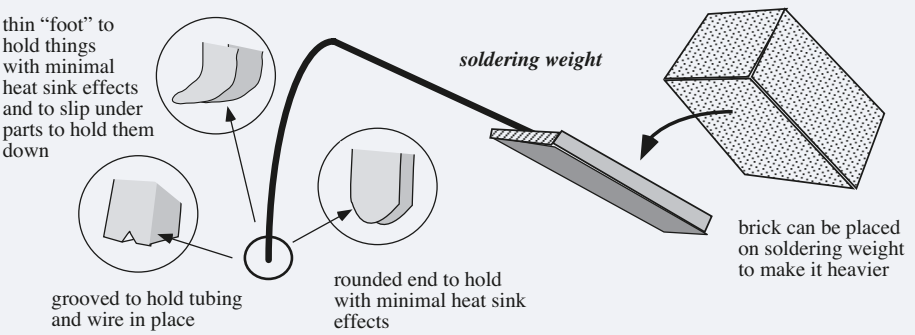
Here are old leather handbags, bought for less than a dollar each at a thrift store. Fill up a plastic bag with sand, knot it, and zip it into the handbag; now you have sandbags with handles. Use them for shaping metal on and as a pitch bowl support. A hot water bottle can be used in the same way, and it will last for years.

A cast steel dumbbell ($5 at a flea market) makes a superb sinking hammer for making bowls.

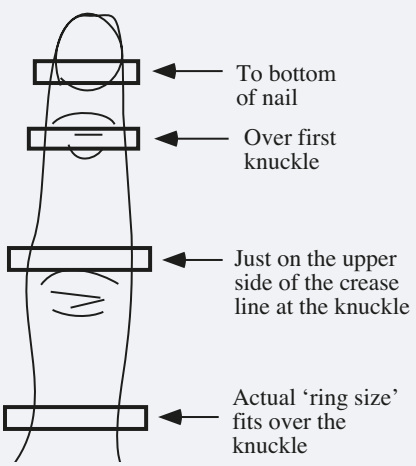


When you need to blow away dust from where you are drilling materials or burring wax, make a little propeller to do so, like this.

Chris Hentz developed this tool for holding things for soldering by brazing three nails together. I have added a sliding magnetic weight to this one.



Here is another form of soldering weight that I like; with two of these you can quickly hold most things while soldering. Its weight is increased by stacking a brick or other weight onto the flat surface.



Memorize your finger sizes for easy ring sizing estimates. I keep a map of mine.

angle and it is a file; tilt it up a bit and it is a graver for refining the scoring.

• **Simplify the procedure.** Boil it down, distill it, reduce the steps, combine steps (like using ZAM or Fabulustre instead of two polishing steps like tripoli and rouge).

• **Look for someone who uses so much of something they do not value it.** If you are looking for a specific material or tool, try and find out which industry uses so much of it that they consider it almost worthless. Here are some examples:

The **flint wheel** from an older-style disposable lighter is a great carbide steel burr that jewelers can otherwise pay several dollars for (see figure 6).

They are made in such quantities that they are incredibly cheap. When the lighter is empty, the top can be knocked and pried apart, and the flint wheel placed on a standard screw mandrel for the flexible shaft to obtain a carbide burr. It works like a rotary file for filing edges and coarse metal removal.

6

Dry pickling acid (you know the ubiquitous brand I mean) is almost the same as sodium bisulfate, which is commonly sold as "swimming pool acid," used to change the pH of swimming pools and hot tubs. It is far less expensive than at the jewelry supplier's ($1.50 for the same amount you would normally pay $7 for). It can also be bought very cheaply in drums as an industrial toilet bowl cleaner. It is also used in some dishwashing powders. What might this say about disposal (once the copper is stripped out of the used solution)?

Large floor polishing machines, such as those used in school or other institutions, have **giant scouring pads** on the bottom. When their pads are "worn out," they are still good for our use; but even better are the round discs that they punch out and throw away from the middles of the pad when they are mounted on the machine. Stiffen up the center with a little epoxy and they are essentially the same scouring discs for the polishing machine that jewelers pay up to $8 each for.

➤ These felt floor protectors for furniture can be used as felt buffs on the flex shaft.

7

Pumice blocks for soldering on, or for getting a satin finish on metal by scrubbing with water, are sold at dollar stores for scrubbing your calluses (see figure 7).

You can find **vibratory tumblers** more cheaply at gun shops than at jewelry suppliery; they are generally about thirty percent cheaper.

Delrin metal forming hammers used for anticlastic raising and metalsmithing often run $38 at jewelry suppliers but are only $8 at discount hardware stores like Harbor Freight, where they are marketed to fix dents in cars. (There are a lot more car mechanics out there than jewelers.)

Similarly, **auto waxes and transparent paints** to protect metal surfaces, designed for expansion and contraction, extremes of temperature, acidic rain, and ultraviolet light are an ideal long-lasting finish for metal objects. In the same way, Nicholas Lacquer, beloved by people who use patinas and metal coloring, is found easily in music stores, as it is used on high-school marching band instruments as the longest lasting finish—a brutal testing ground for a product.

One can buy **cylindrical leather dog chews** in different diameters at the pet store, cut them in half, drill through them, and mount an appropriate-sized hammer handle in them to make inexpensive, good-quality leather mallets, particularly in small sizes (see figure 8). Look for a chew that is solid, as some will have cavities in them. Three small mallets will cost just about $2.

8

Master goldsmith Charles Lewton-Brain is the innovator of Fold-Forming, professor emerita of the Alberta College of Art and Design, and a founding partner of ganoskin.com. He lectures and publishes internationally on his research into rapid manipulation of metal and its surface for artistic and manufacturing purposes.