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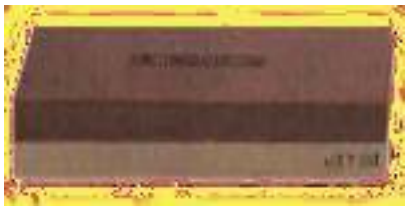
Sharpening experiences

James

- Skills and guides - DYI, Making things. -



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Description :

Sharpening is a vast topic, I'll expose here my personal views on sharpening knives, and tools. This is not a how-to, there are many available every where, including the net.

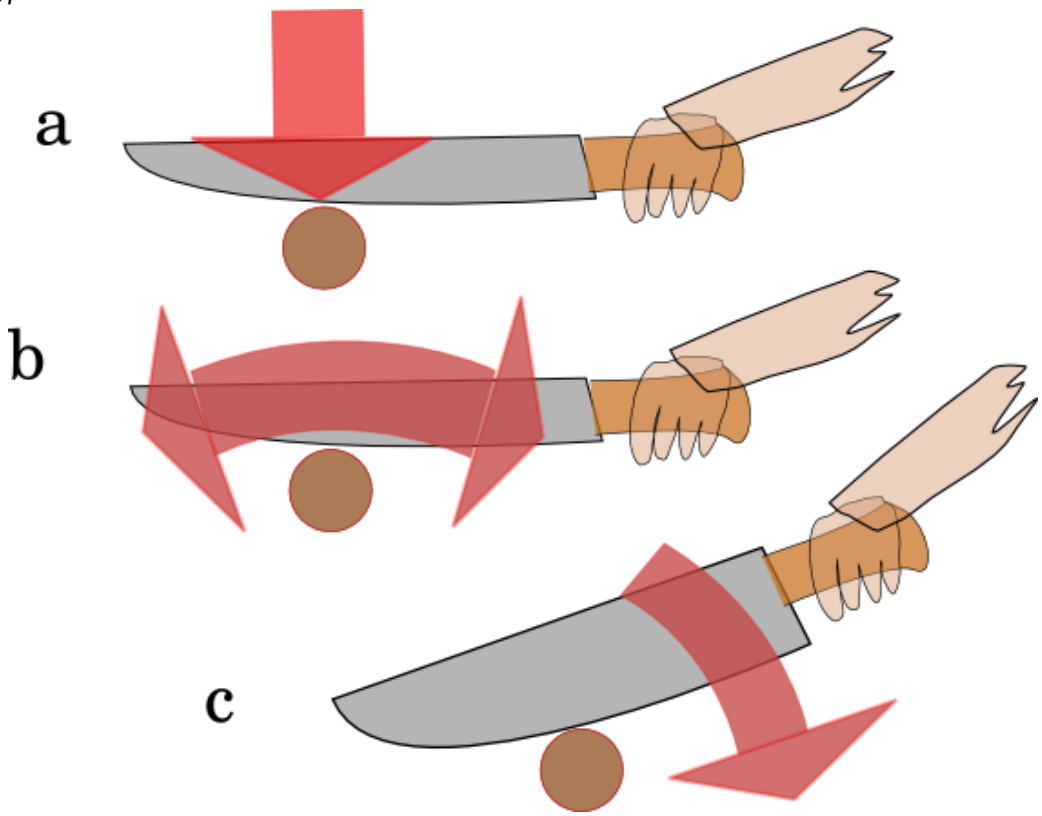
Nowadays, when you buy a new knife, it generally is "razor sharp", meaning it can shave an arm. But soon enough it gets dull, and I found that a lot of people are afraid, or do not know how to sharpen it.

But sharp is just a word that describes an experience, let's have a look at what is the meaning of sharp:

How "sharp" is this ? : Utilisation

With experience, one comes to understand that "sharp" may have different meaning, depending on the use of the tool. Knives and cutting tools have different ways of being used:

The different types of cuts one can use



Types of cuts

a): Pushing.

b): Slicing.

c): Rolling.

1. **Push cuts**: The tool is used like a razor, the edge attacks the material perpendicularly, here tests have shown that the factor is to get an edge as finely polished as possible, meaning that the finer the grit of the abrasive, the better the cut is. A razor by example is used for push-cuts. Hatchets, axes, planes, or machete work uses push-cuts.
2. **Slice cuts**: The tool is used to cut a slice, by pulling and pushing the edge on it's whole length, along the material, like if using a saw. There is little down pressure applied. Here, tests have shown that the polished

edge, is not the most efficient, and that a coarser edge, cuts the material better. It is easy to understand why a coarser edge acts like a saw with micro-teeth. Kitchen knives are generally used as slicers, but the improvement from the coarse edge is rather better perceived on ropes, plastics, and other hard or fibrous materials than on soft food. Some tests on such material, have even shown that a coarse edge is more efficient than a serrated edge.

3. **In between : Shearing cuts**: But of course, these are extremes, and generally we cut things using a mix of both slice and pushing cuts. Cutting wood is an example where such a mix is useful, and more efficient that one of the previous types of cuts taken separately. The 45 degrees angled blade on the infamous French guillotine is said to bring as much as 40% more cutting power.

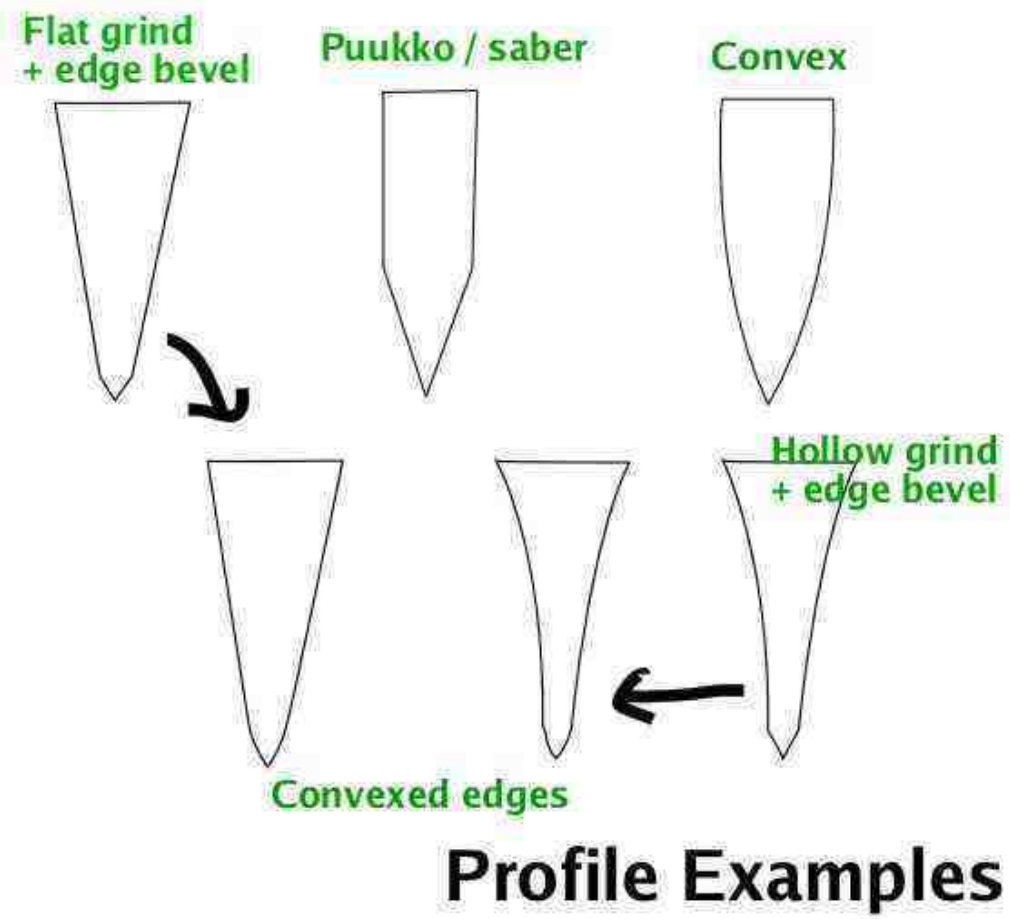
Knowing this, you will be able to adapt your sharpening to the tool you use, it is obvious that a hatchet is better with a polished edge, when a kitchen knife will be happier with a coarser edge, and a knife mainly used to cut rope, with a very coarse edge. But most certainly, you will choose a level in between. I often, for folders, polish a part of the edge, and let another part coarse (which is a very versatile solution, much better in my taste than the serrated edges combos that some manufacturers are selling).

How "sharp" is this ? : Edge Profile and geometry

Now surely, it cannot be so simple, the edge, the steepness of the bevels, if any, or the presence of convex, flat or concave bevels, the number of bevels, and their size, the thickness of the blade, its outline (like a skinner, or straight, or recurved), and profile, change the penetration in the material to cut.

Some solutions like the convex edge, allow for good cutting, as well as good wear resistance and sturdiness. They also provide better general cutting abilities, which is easy to understand in this century where hydrodynamics and aerodynamics are better understood and mastered.

Example of some cutting tools profiles. The profiles are intentionally exaggerated.



Some geometries present a cutting bevel, some not. The finest the edge will be the easier the cut, but also the more fragile it is. So all the art will be into finding a compromise acceptable to your all or most needs and usage.

How "sharp" is this ? : Different steels

As if it was not already complex, the steel used for the too, as well as the treatment it received changes the ability to be sharp and to keep sharp.

Forged steels, very pure carbon steels, heat treatment, quench, draw, or cryogenic treatments all contribute to two main factors:

- **Grain size.** This factor often overlooked today, tells you more or less how thin the microscopic edge can be without chipping. Big grain size is sign of big carbides and coarse steel matrix, it does not get an edge as thin as fine grain. There is by example no comparison between the edge that a very pure 1.2 C Shiro-gami Hitashi steel can take, and the edge a D2 blade can take (though obviously it is just a generic remark, as specific craftsmanship, or lack of craftsmanship can reverse things). The grain size, though mostly irrelevant when talking about coarse edges, is a key factor for polished edges.

- **Wear resistance and sharpenability.** Obviously, a sharp knife that gets dull immediately is not that great. I am not however too fund of very high wear resistance, because it is generally (and only generally) linked with low machinability, and thus low sharpenability. Generally speaking, carbon steel is easier to resharpen than stainless

steel, which contains harder chromium carbides. Some of these steels keep an edge a long time, but need specialized equipment to be brought back to a good cutting state.

- **Find the good steel.** Very often, and even if the makers of the knife took a great care, during the quenching, tempering and grinding process, happens a decarburisation of the outer layers of the blade. The edge does not take an edge easily, rolls a lot, or makes easily of wire edge, seems soft, deforms on impact. If such is the case, try a **strong sharpening**, removing a good amount of steel on each side, so that the edge's steel will be some tenth of millimetres back from it's current position. You can also take the occasion to lay your preferred type of edge. And hopefully you will find very good steel there, as you will removed the decarburised, or locally heated steel. This is quite obvious on axes and extensively forged carbon steel knives and machetes. It can sometimes be a very impressive effect. Forged axes, moras, golok, kukri, machetes, my own forging results, have in my experience shown such effect, and the difference in behaviour is huge, and makes what could have been though a poor blade, a very good one.

The importance of the steel must not be over-emphasised, but should not be neglected either.

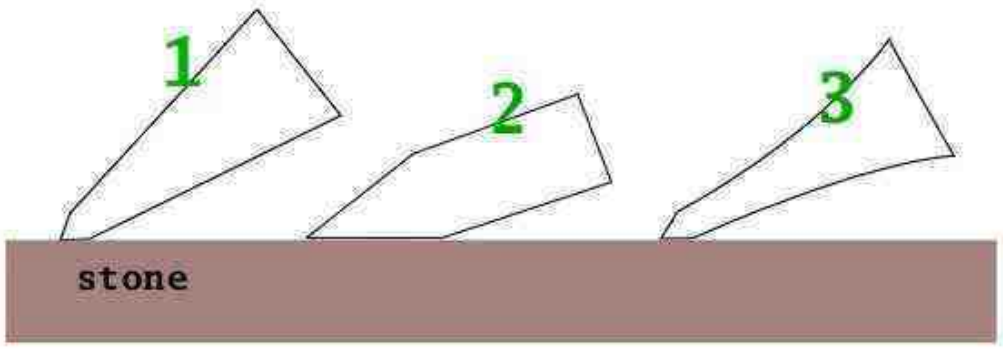
How "sharp" is this ? : Keeping sharp

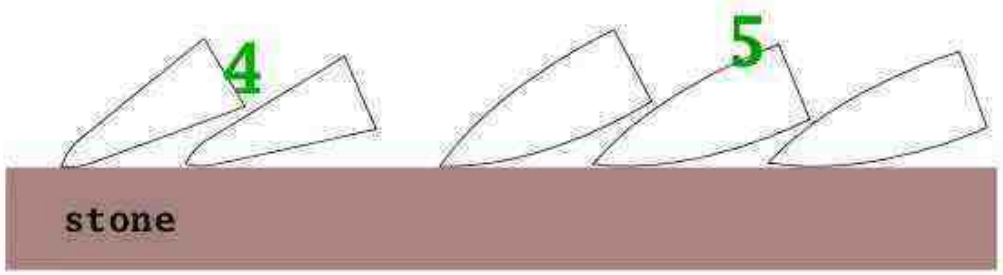
Some people use a knife until it does not cut anymore, and some keep it sharp all the way. The second option is in my own opinion better, as an edge that has started to dull will degrade faster through micro-chipping, and more than an edge that is kept sharp. Understand here that there will be more work to restore the sharpness. So it is better to keep touching the edge while working. A steel or a burnisher, or a fine ceramic rod is great to do this, as it realigns the edge and gives it a longer life.

Getting to work

Now that we understand what makes a knife sharp, or what makes us think it is sharp, because it is efficient, let's try to keep good things and improve bad factors.

finding the right angle





Finding the right angle

Common factory knives ***(1 &3 on figure)*** Generally, on commercial knives, there is a noticeable bevel formed by the cutting edge, regardless of the main bevel type. This does not help penetration in any material, for the same reason that airplanes' wings and boats' fans do not have any edge on their angle of attack: simple material penetration dynamics. But it does lead to this remark: like for wings, the speed will call for better profiles (thin while resistant: axes, goloks, hatchets, any fully convex blade), while low speed cutting calls for a thin edge of any kind.

Bevels have the disadvantage that after a lot of sharpening the edge will thicken.

I have owned many old knives, and I can tell you our grand parents never kept the original bevels, they were sharpening on all the surface of the blade, and they were maintaining the thinness of the edge.

So my recommendation here is to round these factory edge bevels as much as possible *(4 on the figure)*. It will surely change the look of the knife, so this advice is not for collectors, but for users.

Scandinavian edges ***(2 on figure)*** On Scandinavian knives, the edge bevel is huge, and is the only one, it is recommended to sharpen it all, and makes sharpening very easy, as the bevel maintains itself flat on the stones. Near the very edge, most people then just convex it very slightly (1/10th of mm).

Hollow bevels Depending in the geometry of the blade, some hollow bevels are better sharpened like a Scandinavian edge (considering it flat, and laying the edge, and back of the bevel flat on the stone, it will sharpen very fast, and very sharp!). Some others are better sharpened keeping an edge bevel, in order to avoid a too shallow angled edge.

Single bevel For these blades (chisels) that are flat on one side and have only one edge bevel on the other side, the secret is to sharpen the bevel, and remove the wire edge from the flat side (by sanding flat).

Convex blades *(5 on figure)* For convex blades, the important thing is to maintain the profile (or make your own like OldJimbo and myself) to its optimum efficiency. The sharpening can therefore go on a large amount behind the edge, for some centimetres, which will avoid the creation of a bevel, and a lot of work to remove it, by maintaining the profile.

What is generally said about the convex edge is that is is normally thicker than a beveled edge.

Wrong: a convex edge or blade can be made as thin as wanted, and obviously, a convex blade that has the same thickness than a flat V blade with steeper bevels will slice better! Another common mistake I have read about convex edges is that they cannot be sharpened on a flat stone, but only on a slack belt, Yeah sure, as if you could not use a flat file to file a rounded form!

Dents and over-sharpening Dents, are generally treated by flattening the edge where the dent is (edge perpendicular to stone), and then bringing this flat edge back to sharpness. Dents and over sharpening, may force you to rework the secondary bevels or the profile. It will get messy and scratched, but the knife will keep its efficiency, and you can bring it back to some good looking by rubbing finer and finer grits sand papers on the whole length of the blade.

Angle(s) Of course also the angle is important, everybody can understand that a steep angle cuts less than a shallow angle. But a steep angle is more resistant to wear, so it is at the end your experience, the planned use, and the type of steel that will determine the angle.

But even maintaining a knife without trying to improve it, takes some time. The first thing I do is to rest the edge flat on the stone, and find the appropriate angle, by turning the handle. The right angle is just at the limit where there is space between the extreme edge and the stone, and where it touches. Then, when the angle is understood by vision and hands, I sharpen. I repeat the same process for the other side... *Check the previous figure, it helps understanding*.

Sharpening against (cutting into, motion from edge to back) the bench stone allows to feel when the angle goes wrong, as it "bites" into the stone, and correct this earlier.

Maintaining the angle does not mean having a "blocked" movement, but one that adapts to the geometry. While the angle near the handle is made by turning the handle, at the tip of the blade, it is made by raising the butt of the handle. Therefore, often the correct sharpening movement is actually a movement in the 3 dimensions.

This topic on our forums will explain the exact movement.

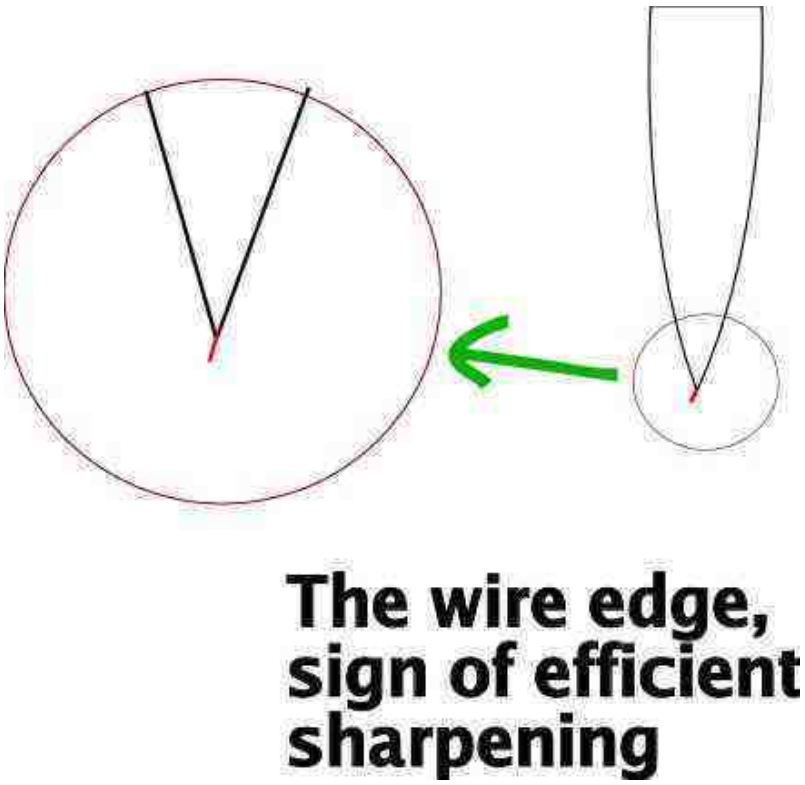
For the last few strokes, it is good to go very light (feather light), with a bit more angle.

Apply the same number of strokes and the same pressure on each side.

You will probably notice that most production knives are not symmetric at all, either in angle, or bevel size ! You can correct this easily.

Repeat all the process with a finer grit until the edge is adequately polished.

The wire edge



The sign of a working sharpening is the creation of a wire edge. The wire edge grips, when passing the thumb or a nail from behind the edge, and away from the edge. It disappears with finer grits, polishing, or burnishing (or cutting cardboard). It only shows on one side. It is the sign that you removed metal down to the very edge.

Cutting into the bench stones makes a smaller wire edge, and often also a sharper edge. It indeed only applies to hard sharpening material!

The wire edge can often be removed by "sawing" a piece of wood, or stropping using a fine polish paste, or using finer grits, or lighter stokes (in the case of steel or carbide cutter). It is absolutely needed to remove it totally for chopping tools and push cutting applications, as it may damage the edge up to the point of inducing bad edge chipping and very very poor edge holding.

The sharpeners

There are loads of different systems to sharpen a knife. Some are guided, some are for use free hand, some high tech, some as old as the world.

The guided systems Good for beginners, the stone is guided though a guide fixed on the blade, they allow to

maintain an angle, but on the disadvantages, it also maintains a bevel, which as I said is not really the most efficient. They also often cannot sharpen more than 4" at a time. Lansky, DMT and lots of other are available on the market. With experience, you'll find them useless and slow to deploy. I call those gadgets.

The semi-guided systems Two stones are set at the right angle (between 20 and 30 degrees to vertical, in a wooden or plastic base, possibly with a set of two angles available, the user holds the blade vertically against the stones. Spyderco Sharpmaker is the example of this kind, among others. This is more versatile than the previous system, as it allows sharpening any size of blade, as the guide is not fixed to the knife, but a reference to the vertical plane. The double angled systems allow flattening the edge of the bevels of factory knives. They are a must for beginners, and can also be used free hand later.

Free hand sharpening Whether it is a bench stone on which the blade is passed, or a stick or carbide cutter passed on the blade, the system is the same, there is no guide, except the knowledge of the hands and eyes It may be disastrous when done by beginners, and a marvel when performed by an experienced person.

One must learn to understand a blade's geometry, and to maintain one or many angles constant before mastering the technique. It gets tricky with knives whose bevels change steepness over the length of the blade like some puukkos, and then it is not about maintaining an angle, but a movement spanning from an angle to another! The results are in all the cases well worth the effort. The beginner may have to train on cheap knives like wide beveled Moras.

The results obtained using free hand sharpening hardly compare with mechanized sharpening, once the craftsman knows it's job.

Mechanized systems Well, lots of systems are available, from band systems, to circular whetstones systems, though grindstones, and my personal favorite, the angle-grinder equipped with a rubber padded hard plate, and sand paper... The danger is always to remove too much, to generate too much heat, or to make the blade fly in the air. Use at your own risk. But for blades that need a lot of work / rework, and if you have not studied Zen and the art of Japanese sword polishing[:)] , they are the solution.

The abrasives

I have over the years used a lot of different abrasives, and here are my findings, starting with the most efficient.

Japanese watersone

The Japanese waterstone are of two kinds: natural and artificial. The natural ones are getting rare, and the artificial are cheaper and efficient. As the name explains, they are soaked in water before use, and a sort of slurry forms on the top while sharpening. The slurry helps the stone cut better, and is also the sign the abrasive does not get clogged. The water also ensures that whatever is done, no heat will be produced that could destroy the temper. The Japanese waterstones are the fastest abrasives I know of for blades, even fastest than diamond! The only draw back, is that the material is soft and is abraded by the blade, so the stones need to be trued to flat after some time.

Japanese sword polishers actually recommend the use of convex stones for the coarser grits. Read this excellent article and understand more about these technics.

Studies from wood workers show that the advantage in speed and finish of the natural stones can only be seen on steels whose hardness is > 63 HRC, Which is fine for us because a 8000 [1] Awase costs some 150$ [2], a 2000 Aoto 70$, a 1000 Binsui 40$!

They make now some new stones which are ceramic bonded (they are still not to be mistaken for pure ceramics as they do loose grit) but are a bit more resistant to wear, and almost as efficient.

There are multiple grits [3]:

- 250 to 350 are coarse, for working on chips, and dents, or heavy profiling.
- 800 to 1200 are the sharpening grit. Take care, that though it is fine, it removes material faster then other abrasives.
- 3000-4000 Medium finish grit.
- 6000-8000 Finish grit, very close to polished surface.

Prices for artificial stones vary a lot, from 215 to 70$, most combination stones of the biggest size (8" or 20 cm long) are between 20 and 30$.

I have since bought some natural Japanese stones, and they are great too. Ohmura 150-300 grit, the coarse one. Amakusa 400-600 grit , medium coarse Binsu 800-1200 grit, medium Ginzo (artificial ao toishi) 1000-3000 grit (the finer stones being too expensive for me, as over 50 US$ (ao) and the finer (awase) over 110$.

Some Nortons are waterstones though, and work as well as Japanese waterstones, I got one of these mounted on a wood handle, and it is a marvelous profiling tool for big blades, and small enough to carry in the field.

Artificial oil Stones

Like the Norton stones, I tend not to use them, because oil is messy, but they work well. The Norton India artificial stones are reasonably prices and work well, and last a long time. I have a combination India, coarse/fine, which I

carry more and more with me, as I find a coarse stone more useful in the field than a very fine one, and I really find this combination excellent, for a good price too.

Diamond

Diamond bench stones have been available for a while now. The surface in diamond grit held in a nickel coating over a steel plate. They remove material very fast, like a Japanese stone, but in my experience, they are expensive, and do not last long, because though the diamond is one of the hardest material on earth, the nickel bonding is abraded by the blades, and the diamond grit liberated, thus making the stone almost inefficient after a relatively short time. And once you have used the superficial diamond coating, the thing can really be thrown away. I found diamond coated stones have a life in efficiency. They are over aggressive when new, get ok after 10 or so sharpening passes, for 50 or so more sharpening passes, and then they become poor performers.

Reasonable size diamond coated bench stones are expensive, count 80 to 180$.

Ceramics

I have also tried ceramic stones and bench stones. Here the problem is the opposite to diamond, they last forever, but they do not cut that well, because the ceramic gets clogged (whatever the maker tells you), and needs frequent cleaning to work well.

Ceramics are relatively cheap: 30 to 40$ for a bench stone. Pure ceramics are never coarse, medium at best.

Leather strop

The razor leather stop is a tool designed to bring a fine polish on the edge. It can be used with other blades than razors, and the result is most of the time frightening!

Count 30$ with green paste.

Arkansas

Natural stone with a grit of 8000 (white). See Ceramics. A stick is 10$, a bench stone 50$.

Burnishers, steels, files, carbide cutters

The burnisher is a tool made of hard steel, or any other hard material, polished, and is used to realign the edges of a cutting tool. It often avoids sharpening, it has the advantage that it does not remove metal, just pushes it back in position. It works better on blades that are not too hard (less than 57 HRC), and gives them many more lives before re-sharpening. The tail of a hardened drill, or of a file if it is round, makes a good cheap burnisher. A small fine Arkansas can be used as a burnisher (though it removes a little material).

Burnishing a knife takes a few seconds, and makes the edge feel like recently sharpened. It gives more life to the edge than letting it slowly degrade, because an edge degrades on two factors: abrasion and deformation.

deformation leads to micro-chipping from abrasion and speeds the process of getting dull a lot. A steel or a burnisher corrects some of the deformations, before micro-chipping occurs (that is why it has to be done often).

Depending on what you cut, if the material is abrasive, the burnisher will not realign any edge steel ad the problem of this type of bluntness is missing material, so the edge needs to be thinned by abrasion(stones), filing, or cutting:

A steel is a burnisher whose surface has a filing effect. It removes material from the edge, and is a highly efficient way to quickly sharpen an edge too, that is probably why butchers use them a lot.

You can also buy of of these carbide cutter/sharpeners. It is generally a square or M shaped carbide head, that is passed along the edge, it does not abrade, but cuts into the steel and shaves a thin layer. A blur is quickly obtained, and a knife or axe are made sharp in seconds. It will not do to recover chips, but as long as the edge is straight, and the steel not too hard. it does marvels in seconds, specially if followed by a burnisher. [4]

Another tool that can be used is a file. For file sharpening, the steel must be reasonably soft, and the file adequately teethed, often a "sharpening model". A very common way to maintain an axe. But there must be something else done to the very edge if a polished state is needed.

I generally use a burnisher, and use a stone or carbide cutter to remove edge material only when needed.

The burnisher, steels and cutters also brings the question to know if it is better to have a knife with a hard edge, which will hold a long time and needs a lot of work and time to be resharpened, or a knife with a softer edge and a burnisher, which will also hold some good time, but whose sharpening is a question of seconds? ...

Impossibilities

It is impossible to sharpen a recurved portion of a blade on a flat stone. Worst than ruining the edge, it will ruin the stone. The only solution is a stick or hand-held small stone, or a carbide cutter or a steel.

Cheap and field emergency sharpening

Sand papers Sand papers are not a stupid idea, whether glued to a flat wooden board, or to a mouse pad for convex edges sharpening, or in the pocket, they are highly efficient, at a very low price, and they take no space or weight. The mouse pad glued sand paper is a very efficient and easy solution favored by many outdoormen, especially for convex edges.

Back of plates, or ceramic kitchen ware / pottery You can use this as an emergency sharpening; it is ceramics after all no?

Edge of car glasses, beer bottles/ glasses The edges of car glasses are abrasive enough, and any glass surface can be used as a burnisher.

Other blades, metal bits The back of other blades makes good burnishers too (except with differentially tempered

blades). Drill tails, file tails, screw drivers are good burnishers too. A fine file can be used to coarsely sharpen an edge.

Stones Stones can be used. Choose one of the right grit, and flat enough. River bed stones are generally great for this. Works better with water.

Wood and dust/sand/mud This technique is described by Jeff Randall in . Basically pick a baton, split it, make little holes in it, and add sand, or finer dust, depending on the effect you wish to attain. An alternative is the edge of a rubber shoe sole after a dusty or muddy walk.

My choices

At home, nowadays I have come to the following tools:

1. Japanese waterstone King 250
2. Japanese waterstone King 320
3. Japanese waterstone Cerax 1000/3000
4. Fine Arkansas (8000 grain) used as burnisher.
5. A razor strop and green jeweler paste, for real fine polished edges.

I use the waterstone 250 for reprofiling, removing dents. The 320 gives a finer surface, The 1000 grit is used for sharpening, slicing knives are left in that state, or brought to the 3000. Push cut knives are finished with a 6000, or polished with the strop.

I have convexed the surface of the coarser grits stones, as it makes it more precise to remove the material where I want it. Most advice you may read on sharpening using Japanese bench stones is written for wood workers sharpening chisel blades, in which case the flatness of the stone is essential. Japanese sword polishers use convexed stones for the coarser grits, because it allows more control, and I tried, and they are right, it works much better for all knives and outdoors edged tools geometries.

The Arkansas as I said, I use as a burnisher, and a few passes of it bring back a razor sharpness. But I also have a small field steel, Opinel brand.

In the field, a double-sided small spyderco ceramic is generally enough. It can too be used to burnish. But recently, I have replaced it with a Norton India combination stone. I also use nowadays a carbide cutter and burnisher.

I do not use anymore:

- Spyderco Sharpmaker (or only the ceramic sticks in the hand on recurved blades). Still, it has merits, and is the best guided system I have seen. I was useful when I was learning, but it still imposes its geometry on the edges.
- DMT aligner, not able to sharpen more than 4" in a go, it lasted a week, I kept the stones:
- DMT Stones, I now use them to true my Japanese waterstones, as they lost they cutting power.
- Spyderco ceramic benches, medium, fine and extra-fine. Too slow, though the extra-fine is a good polisher. Gets clogged too quickly, and are difficult to clean well.

Conclusions

Sharpening is a complex knowledge to acquire, because it is based on the understanding of the function of the edge that needs to be sharpened. I hope this article might help those that need to sharpen a bladed tool, and avoid them some mistakes.

Post-scriptum :

Follow up: Convex Profiling and Sharpening by Hand HOW-TO

You can also comment this article using the feature below.

Updated 08-07-2004. Updated 15-05-2005. Added sword polishing, and general tips. Updated 29-01-2007. Paragraph about finding good steel.

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[1] All the grit numbers in this article are Japanese

[2] $+-=Euro

[3] Japanese grits are not to mix with US grits, a 1000 Jap. is a 500 US, a 4000. Jap is a 1000 US

[4] They in addition throw amazing sparks when used with a firesteel