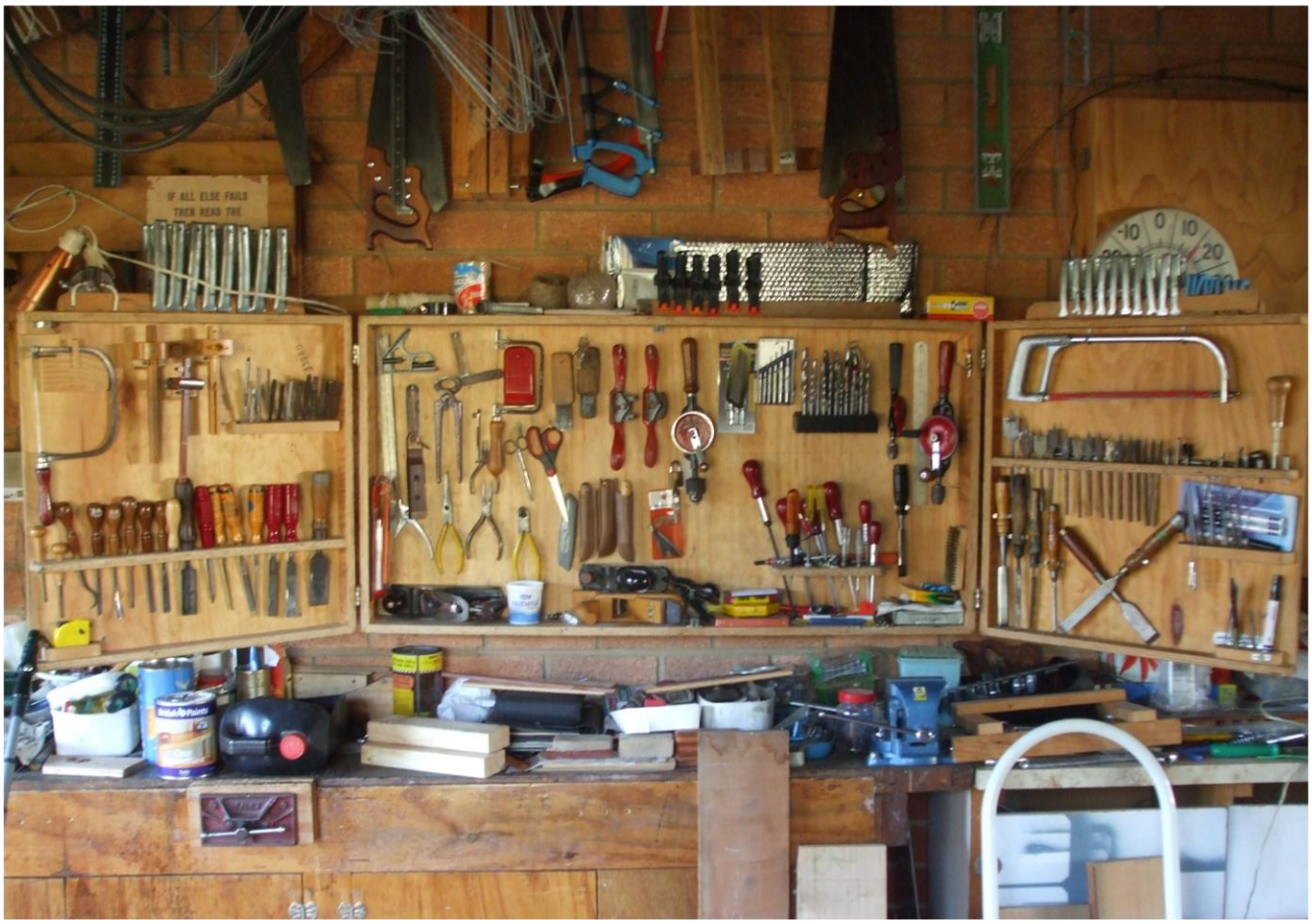
The Sustainable Workshop



www.underthechokotree.com
Sustainable Living in the Suburbs

By Nev Sweeney &
Bill Tarplee

Thirty years ago, an old friend of mine the Bill Tarplee referred to above was operating a magazine out of Canberra and he wrote a series of articles on buying, doing up, sharpening and looking after hand tools plus how he set up his workshop. Bill was a manual arts teacher at one stage, very skilful with his hands and knows all that there is to know about hand tools (among other things). I have been lucky enough to secure his permission to republish some of his original articles in this eBook.

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1.0 Introduction

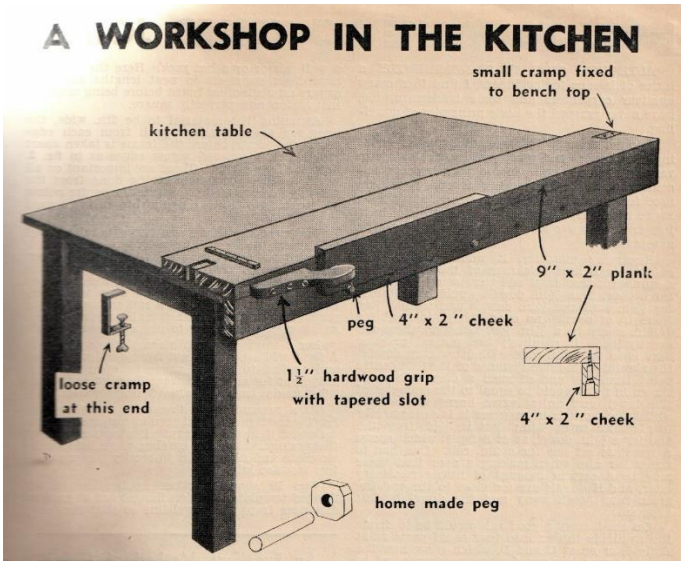
Why does having some area that can be used as a workshop make living more sustainably easier? For me there are a number of points –

1. It provide a space allow you to conduct repairs and maintenance on your car and other bits of machinery and equipment you have hanging around,

2. It provide and area to carry out sustainability related projects, like making a solar over, putting together a load of ollas or deep pipes for more efficient watering or constructing a cold frame.

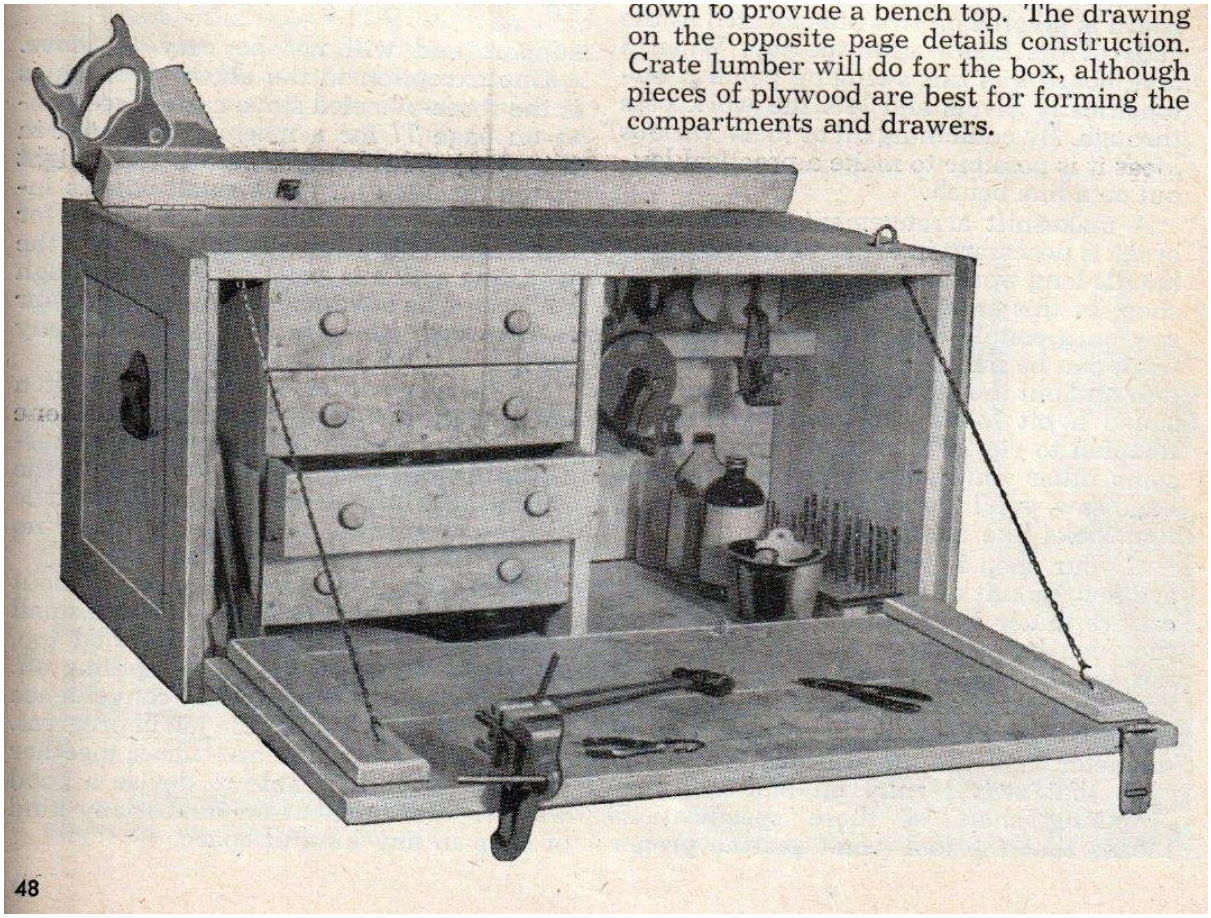
3. A workshop area can provide a place to organise and store tools and materials.

A workshop area can be part of a garage or in a shed, but it doesn't have to be huge. When I lived at home, we had neither so project work and repairs and maintenance were carried out on the dining room table. Likewise, in our early years before we built the garage I carried on that tradition as well. In fact I still do simple repairs and maintenance on the dining room table because it is warm (or cool) inside, is at a comfortable height, is well lit and is convenient. It was the go-to place to work when the TV had heart failure some time ago.



From 'New Australian Home Carpentry' published by Colorgravure Publications 1951

There are old designs from back in the ‘40s and ‘50s of small, multipurpose bits of furniture that were designed as workshop areas for apartments and other small homes that you could make yourself. I have included some illustrations of those below. There are also designs for additions to the kitchen table (admittedly, a bit more robust that ones around today) to make them a bit more versatile as a work area. I find both ideas fascinating, but since we have the garage, I have never had cause to pursue them.
So, as you can see, you don’t need a vast workshop to be able to do the bits and pieces you need to, it is just a case of looking around and identifying an area that works for you.


down to provide a bench top. The drawing on the opposite page details construction. Crate lumber will do for the box, although pieces of plywood are best for forming the compartments and drawers.

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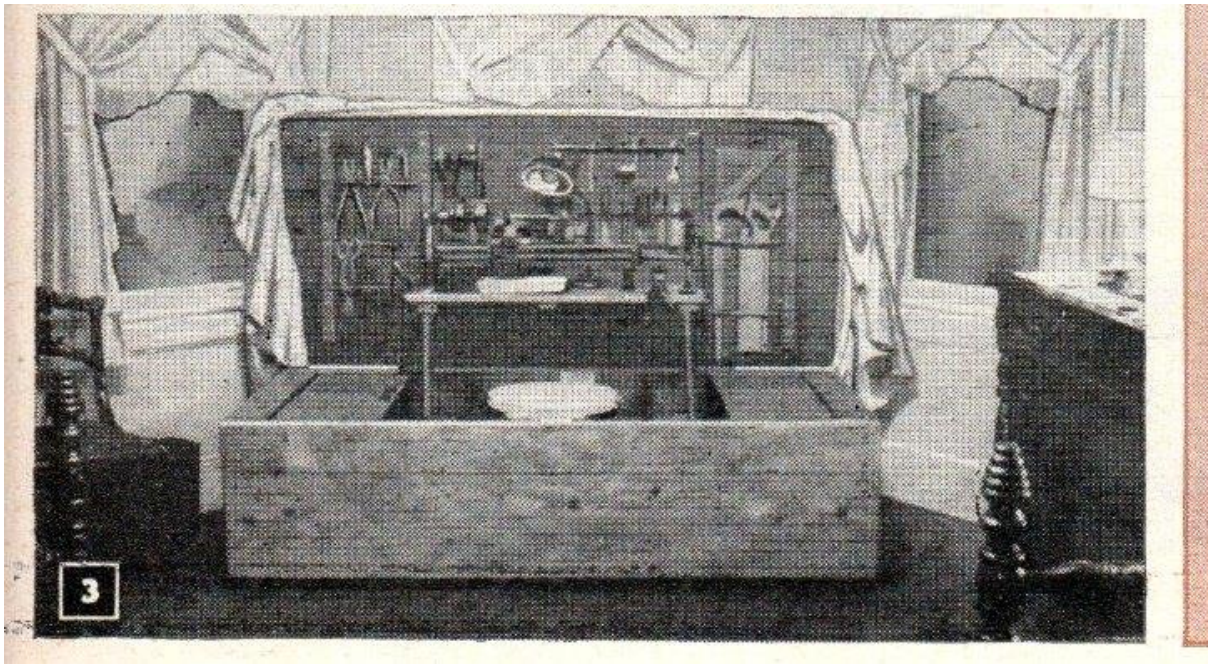
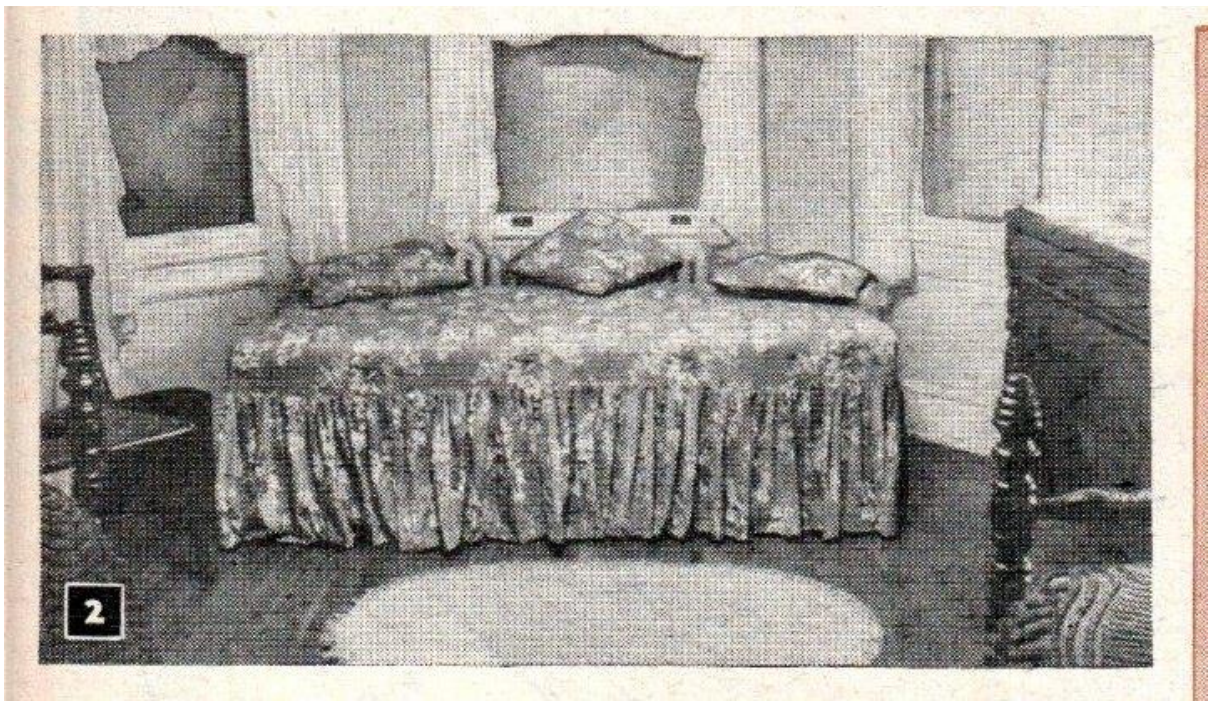
This photo of the ‘Apartment Workshop’ and the one on the next page are taken from ‘Planning Your Home Workshop’ by Popular Mechanics, edited by Sam Brown 1949





A Studio Couch workshop

Note: More details are available in Appendix 1

2.0 Setting Up

2.1 Setting up the Garage – Tool Storage

One of the tasks that many of us face in the setting up of a practical, well laid-out workshop and while this should be an enjoyable job, it is one that requires much thought and planning if we are to achieve maximum usage of the available space. This is the way I have set up a very small garage to hold a wide range of wood and metalworking equipment. While you may not have such a restricted space, I believe that by following my example you will gain better value from your available space.

My garage is solid brick and is about seven metres long, by just over three metres wide. Since I like to park the car under cover, i have had to design my tool storage around the car parking space.

Firstly, I should point out that I used a similar method of construction for both my cupboards and moveable stands, the heavy machinery has required greater strengthening of the stands and somewhat heavier materials but that is all.

I chose to use plywood for all my construction, it is the cheapest material available in this locality and has by far the greatest strength. Chipboard will do the job, but it is heavier and will bow and bend underweight. If you can't obtain ply, by all means use chipboard, floorboards or even the heavier thicknesses of Masonite on a wooden framework.

My basic construction method is to make up a box of ply. I use ply ranging from 12 mm to 25mm in thickness depending on what weight it has to support.

My first step is to decide upon the size required. In the instance of my general tools cupboard, I used some old imperial sheets of ply 4 foot by 2 foot by ½ inch (1 metre x ½ metre x 12mm). I cut out sides 1 metre x 150mm and edges 500mm x 150mm (two of each). These I nailed and glued on the flat garage floor. I then nailed the front and back

to the sides and used a nail punch to drive all the 25mm jolt head nails below the surface. While I was waiting for the glue to dry, I filled all the nail holes. When I am filling furniture that is purely for my own use, I usually mix up a small quantity of Plastibond, as it sets quickly and doesn't show to any degree on pine.

I like to leave the glue to dry for a day and then smooth off any overlapping edges with a very sharp smoothing plane – No4. I then use the same plane to round all the edges. With that done, I sand down the entire case with an orbital sander so that I get a smooth finish on all surfaces and edges.

In the case of the tool cupboard pictured the front ie doors holds a variety of hand tools thus they require some thickness. I mark a line 25mm from the front along each side and edge with a marking gauge, but you could draw the line with a pencil if you wish.

Using a tenon saw, because of its fine cut (kerf) I cut across each corner so that the cut runs along each side and end for about 100mm. This is about as far as you can cut before the stiffening rib on the back of the saw fouls the wood. Cut each of the four corners in this manner.

Using the end (toe) of the saw, with the handle slightly raised, cut toward the middle of the side or end. Just before reaching the middle, stop and cut from the other end, leaving about 50mm of uncut wood in the middle of each side and end.

Preferably using butterfly hinges, hinge each end at the top and bottom, then cut out the remaining sections. Cut across the front of the box and the two doors will open out. Varnish the outer surface (and inside too if you wish) and fit a pair of magnetic catches and you are ready to hang the cupboard on the wall. All my cupboards are supported on screws run into plastic plugs in the bricks.

In the case of the main tool cupboard, I masked around the edges and applied two coats of blackboard paint after the varnish had dried. I glued a thin board to the bottom for a chalk rack and glued strips to the top to hold my spring clamps and spotlights. You can arrange the inside to hold whatever tools you wish.

I have another tool cupboard of this type of construction but in this case it is mounted vertically, whereas the first was mounted horizontally. The second holds most of my files, my glues, my abrasives and oil stones. In it I fitted several shelves in the back of the case and used the doors to hang files. Each file is held by a spring steel clip, which

you can buy in the larger hardware stores.

The machinery is mounted on similar boxes, using somewhat thicker ply. In the stand for my printing press I used 5/8 inch (17mm?) ply as it has to support a vibrating weight of about seventy kilos. Possibly I could have used the 12mm stuff but I didn't want it to collapse half way through a printing run.

In this instance I built the centre shelf, and shelves at one end. The right hand end is set inside the sides by about 150mm. This has given a far stronger construction without any increase in weight, there was no framework used for the construction, the nails being driven through the top and bottom straight into the side plies.

Because of my lack of workshop space, all machinery boxes are moveable. I use a pair of recycled lawn mower wheels, sets of which I usually buy for a dollar a pair (*1980s prices – Nev*). They are mounted through a pair of pine floorboards which are bolted along the bottom of the case, one board being bolted to each side of the case. I use normal black steel rod for the axle, cutting it to length after the two supports have been bolted to the box. You will need the bolts (coach bolts) per side, any more is just wasting bolts.

The wheels project beyond the end of the box and just touch the floor when the box is at rest. I have found that if the wheels constantly support the weight of the machine they will eventually collapse under the strain. This way they only support the weight when the other end of the box is lifted.

Even with the press mounted almost over the wheels, i found that the weight was too great to move comfortably so I fitted a pair of slip shafts. The shafts run through a pair of bent steel straps which are bolted not the bottom of the box. Had the door not fouled the shafts I'd have mounted the shafts lower down.

In cutting the doors out I usually mark the doors out before I nail the case together. I work out the door size required and mark it out with a soft pencil, making as fine a line as possible. I use the end of a jam tin to trace the curve of the corner where the lines join. I drill a hole beneath where a hinge will be screwed and cut out around the line with a sabre saw (erroneously known as a "jig" saw). With the curves in the corners, I can cut out the door with one pass. Had the case been slightly longer or if I hadn't moved one end in to fit the exterior shelves, I'd have cut out two separate doors and left a 100mm strip between the doors. This would have given an even stronger box. (the way it is I've had no problems with the strength.

Note: With all these types of boxes you must work out which way the load will fall. If the box is to support a weight on the top, the top and bottom must overlap the sides, rather than being fit inside the sides. This is the principle used in making card houses, and greatly increases the weight carrying capability.

I made some cupboards to fit inside the recess on top of the garage windows form short lengths of ash floorboards, scrounged from a building site. When polished and varnished they made a high-quality piece of garage furniture. The cupboard fits exactly inside the window recess and is supported on a board that is bolted across the recess. The case sits on the board, and I used one metal strap on the top, which is bolted back to the bricks, and stops the box from tipping forward.

The hammer rack is one that gave me much thought. My dad gave me the idea and i modified it slightly to use up some scrap ply. I comprise of a sheet of ply bolted to the wall, to this is screwed a piece of 25mm ply with the holes in it to accommodate the hammer heads. To stop the hammers tipping forward and falling out, there is a top frame under which the hammers fit. To take the hammer out you pull the head out of the hole and then let the hammer drop down.

If you make a hammer rack, be sure to grease the sides of each hole with car grease, Vaseline or dry lube. If you don't you will find the hammers starting to rust where they contact the bare wood.

If you follow my directions, sand the ply well and apply several coats of varnish or polyurethane, you will produce cupboards equal in quality and finish to any built-in furniture in your house – and cheaper!

2.2 Our Garage

This was originally part of the Permaculture 'Zone Zero' eBook but I thought would provide some understanding of what our workshop space is like and what it enables us to do.

The garage was our first major addition to the house (after the open fireplace) and I needed it to be able to do STUFF.

Our garage is a multipurpose building that is much more than just a place to keep the car, in fact a car has not seen the inside of it since the early days. It is a simple rectangular building roughly 8 metres by three metres, with the front (eastern end) enclosed in brick the same pattern as the house and bearing the roller door, the south and west walls are constructed of a hardwood frame and enclosed with Hardieplank, (and yes, Hardieplank of this vintage contains asbestos, so no cutting or drilling). The north wall is common with the south wall of the house. The roof is rib and pan galvanised sheeting over hardwood joists, sloping down towards the back of the building.

There is no direct access from the house into the garage, but there is a door in the northern wall of the garage which extends past the back of the house, allowing me to get into the garage from the end of the back deck.

The garage has acted as, and enabled me to do a whole stack of things –

Workshop – It has been my workshop first and foremost, it gives me a place out of the weather to do work. This may be conducting repairs or building new stuff from scratch. Building things like ollas or deep pipe waters for irrigation, the solar oven or solar food dehydrator to make direct use of the sun's rays, or to make any number of gardening bits and pieces.

WE have a number of work benches set up with different types of vises that make working by myself easier, that way I don't need to hassle Linda (or anyone else) to hold stuff for me. One of the things my old mate Bill Tarplee taught be was that to be able to do stuff by myself I needed to have vises so I could secure the material being worked on safely. Among other things, we have 2 woodworking vises, 2 engineers vises, a blacksmiths leg vise, a pipe vise, a compound vise and a drill press vise.

We have five benches, two 1800mm x 600mm, two 900mm x 60mm, plus the original 'folding' one, 100mm x 550mm, secured to the wall at the back of the garage under the one and only widow. Of course, some of this area is used to support fixed power tools so not all of the area is available for construction work. How I build the latest one is available later in this eBook.

Tool storage -. It has allowed me to store and use my considerable collection of hand tools as well as a place to use them. It is also a place to set up and use larger power

tools such as the wood lathe, bench drill, table saw, router, small band saw, drop saw, grinder and electric welder. I also had a (large) homemade press and a pipe bender but I needed room and realised I hadn't used either for over 30 years so I donated them to a high school my mate John was teaching at.

Spares/Consumable Storage – This was probably more important when I used to do my own car servicing and we had a pretty comprehensive set of spares for many of the cars we owned. We still have bike spares and spare blades etc for our tools. It can also be irritating to have to whip out at a critical juncture of a build to pick up a screw, nut, bolt or whatever so we have a good collection of consumables to support what we are doing. I am not saying I have never had to whip out to pick something up from the hardware, but many is the time I've been able to find exactly what I needed in my stock of spare nuts, screws and bolts etc.

Bike garage – We have a trike, owned by Linda, which we do use for local transport around St Clair and it not only needs a place to reside, but a place for us to maintain it. The garage suits both of these purposes.

Runoff to tanks – When the garage was originally built the council inspector who checked it agreed I could put some water tanks on the back (western end) rather than wrecking my existing veggie patch by installing a rubble drain. This allowed me to put

two galvanised 500 gallon (2250 litre) water tanks on the back of the garage and for 20 years that was the only water storage we had. They are still in regular use too.

The gutter of the southern face of the house runs over the garage roof for most of its length, because the garage abuts the house on that side, so some years after the garage went in I installed an offtake and valve from the guttering over the garage. This allowed me to take water from the house roof which up until that time, had just gone straight into the stormwater system, and direct it into the tanks.

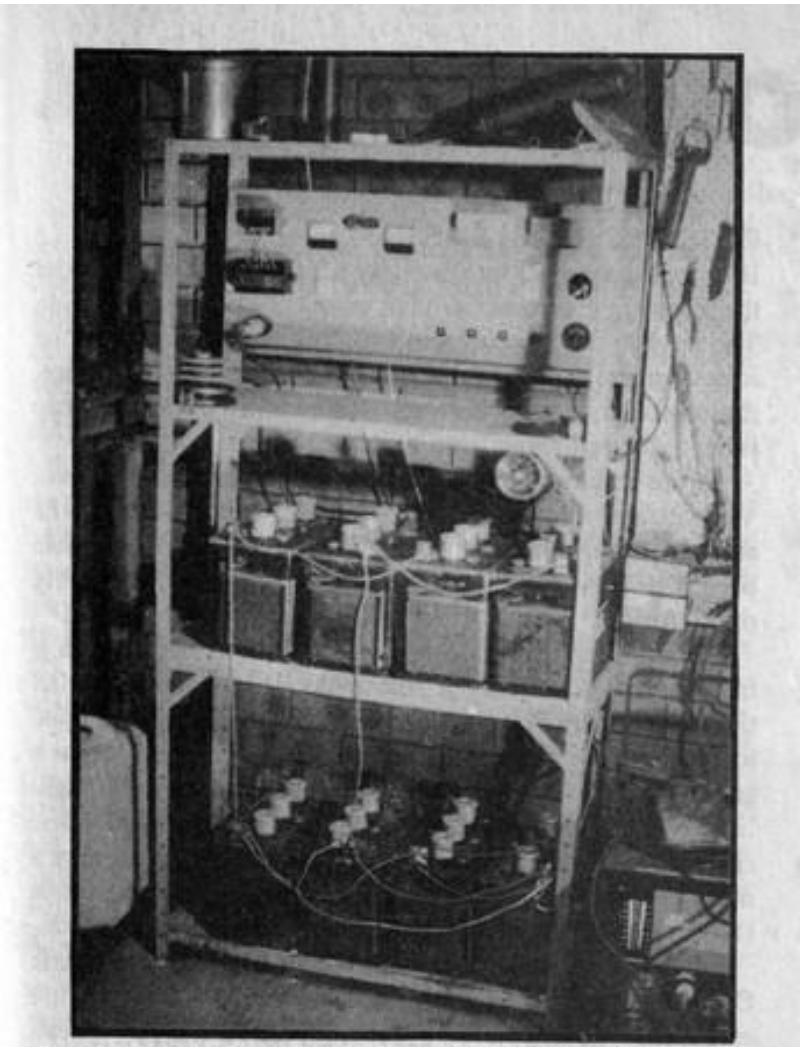
This modification effectively increased the catchment area of the garage roof by about double, ensuring that empty tanks refilled more quickly when we got rain.

Alternative energy set up – The garage facilitated our 12 volt alternative energy set up in a number of ways. Firstly, right from the start, because the long axis of the garage is east-west, it provides an excellent place to mount solar panels. The first solar panel I ever bought over 35 years ago was mounted on the garage because it faced the right direction, was flat and easy to walk (and work) on and the steel roof made it easy to secure the panel mountings to. In fact it remained the only place photovoltaic solar

panels were mounted until we got the back-to-the-grid system installed on the back of the house roof about 10 years ago.

A good proportion of our solar array is still on the garage roof, but we also have panels on the east and western faces of the house too, but the garage roof has been the mainstay of our solar production for over 35 years and will continue to be into the future.

But there's more! When I became interested in setting up the alternative energy system, I needed a place with plenty of ventilation (off-gassing batteries!) and outside the main house to set up the batteries and switchboard etc. With the northern wall of the garage being common with the house it made it an ideal place to set everything up. I could then run the circuits up into the roof of the house through a hole in the brick wall so all the wiring was out of the weather. This also reduced the length of the wiring runs to get the power to where I needed it, thus reducing line losses.



The battery storage and fuseboard for our 12V system, which provides power for lighting and small appliances.

Consequently, when it came time to replace the 12 volt system with the 24/240 volt system, the garage was the ideal place to set things up.

Another thing the garage allowed me to do is to set up a couple of wind generators to contribute power the 12vdc system. Wind generators can be noisy and if installed directly on the house they would transmit vibrations back to the house during times of heavy wind. By mounting them on the garage that prevented the vibrations being a problem.

In general terms, I don't know how far I would have gotten on the alternative energy system with having the garage.

Blacksmith forge – Many years ago I put together a blacksmiths forge which I was going to mount in the garage. I chickened out and set it up outside (not ideal) and then eventually moved it into one of the sheds, but no ventilation installed this was also less than ideal. After many years I got around to setting it up in the garage, and this I am very happy with.

Cover for southern end of the house - The garage effectively shields the southern end of the house from the hot summer sun, because while I use the term 'southern' it is in fact facing slightly west of south, allowing the hot summer sun to hat it up at the end of the day. The garage shades it and keeps it cool reducing solar input to the lounge/dining area on hot summer days.

Trialling Miscellaneous Fun Stuff - like building in this **drink bottle light**, which worked out to be surprisingly effective!

Garages are different things to different people, but having a garage to work and store stuff in has been immensely valuable in our efforts to live a more sustainable life.

2.3 Making a Work Bench

A sustainable lifestyle can be very interesting, rather than hiring people to do things for us we do them ourselves. There are many fun things to build like solar cookers, hay box cookers as well as garden activities like sowing seeds and potting on, and the inevitable maintenance on out homes and the stuff we build. All of this activity is made considerably simpler and easier if we have a flat working surface about waist height, that is to say, a bench! And I know what you are thinking – "If only I had a bench to build a workbench on!" Sorry, I know that is an old joke!

I have a number of benches in my garage two were bought and constructed by me, the other on was built from scratch by me. Building from scratch has a number of advantages –

• You can make it to your own specifications, designed to fulfil the tasks you want it to and to fit in the space you have allocated to it.
• Pre-fab benches are expensive and you can save some cash making your own.

• You can use what you have lying around, or at least you can use second hand or recovered materials, it's your bench so you decide.

But now my lovely partner in the sustainable lifestyle has picked up an interest in woodwork and needed a place of her own in the garage to work. Consequently I cleared an area that was used for storing stuff, like my scrap steel collection I use for blacksmithing, relegating it to the back shed and measured the area to see what I could fit in.

I could fit in a bench 1800mm long and that is long enough to do some serious work on. Unfortunately my timber stocks were a bit low so I had to buy the top and the four legs, these were plantation sustainably grown pine, the rest was stuff I had left over from other projects. I had some 70mm x 19mm thick pine that I could use for the top and bottom rails.

The legs were two 70mm x 70mm x 1800mm long timbers so the first job was to cut them exactly in half using my circular saw. It didn't work to badly but they were not exactly the same length (I'm just a wood butcher at heart I suppose) so I used my wood

rasp and a 12 volt Dremel tool with a little sanding attachment to remove the excess and make them the same length.

I drilled countersunk and then attached the top and bottom rail to the legs with 25mm wood screws with the top and bottom rail overhanging the leg by 19mm so that when I put on the end rails, they would not show from the front and back. So this gave be two squares, the front and back of the bench, composed of two 70mm x 70mm legs and the 70mm x 19mm x 1800mm top and bottom rails. I then cut the top and bottom end rails to 562mm so that the finished top of the bench would be a nice and even 1800 x 600mm.

Once that was in place and screwed the same way as the top rails I put the top surface of the bench which was, as luck would have it, a piece of 19mm pine composite 1800mm x 600mm. You could use ply, or timber boards or just about anything else that will stand up to the years of abuse that a bench will cop. The top was drilled, countersunk and wood screwed down to the top of the legs and into the side of the top rails right around to ensure it was firmly attached.

I was going to use two thicknesses of the pine for the top but in the end I cut out spaces for the legs from the second piece and used it as a shelf to sit on the bottom rails. After I had used the jig saw to make the cut outs I found out that it was too long to go in sideways and slip down into place.....bugger! It was at this point i was grateful to have screwed the top down so I unscrewed it and slid the bottom shelf in and down – it fitted first time, woo hoo! My measurements were a bit rough so I expected to have to play with it a bit but fitting first time was a bonus.

To give the bench stability I drilled and screwed it into the hardwood studs that make up the wall of the garage. I then fitted a 70mm high back board to the rear of the bench to stop tools or small parts being lost over the back.

So that she would have a place to hang “her” tools I got hold of 1800mm x 90mm x 3mm peg board, screwed a frame of 70mm x 19mm pine around the outside and then sat it one the top of the back board and screwed the whole assembly to the wall studs. She seems pretty pleased with the bench set up and you know what they say, happy wife = happy life.

2.4 Installing a Woodworking Vise

The type of vise mostly used for metalworking -the engineers vise – is a very simple vise to install, just bolt it down to the bench where you want it to go, but the woodworking vise is a bit more complicated because it is mounted on the front of the bench. The following method shows how I mounted the vise on the bench which I made for our garage and for which, construction details are covered in another article on this site.

First get your vise

I got hold of a couple of small second-hand vises from the Saturday paddy's market in Flemington (Sydney), they were both steel (I also have an aluminium one) are quite robust and comparatively economically priced. If you are going to get hold of a woodworking vise a steel one that can be fixed correctly to the front of the bench is best. I used to have one that had a screw thread underneath and screwed onto the top of the bench and it wasn't so much economical as CHEAP and totally unsuited to the purpose of woodworking. As with all tools, if you go for a more expensive unit in most cases it will be an investment rather than a cost.

The bench that I am going to install the vise into is the one I made recently for our garage, and is covered in another article.

Deciding where to put it!

The vise needs to be installed so that the top of the jaws is more or less level with the top of the bench, and you should make sure that where you are going to site it has enough clearance on either side to allow you to hold long work without fouling any

obstructions. It is intensely frustrating to be halfway through a job and find that you can go any further because the job is too long to fit in the vise where it is.

Installing the vise

Due to the construction method of my bench I had to remove the front rail and put a cut-away into it to allow the vise to sit at the right height. Having measured up the back of the vise and marked out where the cut out was to go, I unscrewed the front rail to work on it. (another good reason to use screws rather than nails and glue!). I clamped it another vise on an existing bench and then cut in the required depth using a hand saw then, to remove the waste wood I used a 25mm wide chisel and mallet to cut through the wood along the grain. The finish is a bit rough, but does the job.

To mount the vise at the right height I had to cut and fix a 20mm thick block behind the front rail, secured to the underside of the top surface of the bench by four screws run down through the top surface and down into the block. Once that was done I could replace the front rail and then fit the vise by drilling and screwing in four squat coach screws through the mounting holes provided in the vise and into the block mounted behind the front rail.

Installing the soft jaws

So now the vise was essentially installed the only thing to do was cut and fit the soft jaw covers on the inside of the vise jaws, this is to ensure that the wooden work piece being secured by the vise is not damaged by the metal jaws. In most cases these will not be in place when you buy your woodworking vise so you will need to cut and fit them yourself. The best material for the soft jaws is plywood, which is a good trade-off between acting as a cushion but having the strength needed to hold the work as required.

There should be two holed is in each of the metal jaws with the outside surface being countersunk to accept a countersunk screw head. Unfortunately, the small vise I got did not have countersunk holes so to secure the back jaw I drilled and countersunk the front face and then put in screws through the jaw and into the timber of the bench behind. I believe this will work OK for us but this IS NOT the recommended way of fixing the soft jaws, the screws should be installed from the other side and only be so long as they do not penetrate through the surface of the soft jaw. I got hold of some short screws with a large flat head and then screwed them through the front of the vise and into the inside surface of the jaw.

With the installation of the soft jaws the vise is now in place and ready for use!
One word of warning, never leave any vise with the jaws screwed in hard together for any length of time as expansion and contraction of the metal due to temperature changes can damage the nut that the large screw turns through to tighten of loosen the vise.

2.5 Making and installing a Forge

A what?

A forge is a piece of equipment that combines air with a carbonaceous fuel. This achieves temperatures that get steel hot enough to go from the hard, tough material we are used to, to a soft, malleable material we are able to form into any shape we desire. Nowadays this fuel is LPG, but prior to that it was coke (the light material left after the organic materials are burned out of coal, not the black carbonated drink or the white powder some people cram up their noses) and coal; but originally it was charcoal. While charcoal does not quite contain the energy of coke or LPG it will still do the job,

can be home produced and is carbon neutral so that it should be the choice of any aspiring environmental blacksmith.

Years ago a mate of mine in Canberra introduced me to the art of blacksmithing. It was a huge amount of fun and you could make all sorts of things with a bit of practice. He made his own forge based on a (small) truck brake drum and a vacuum cleaner to provide the draught of air, but he did it by running a hose from the exhaust side of his wife's vacuum cleaner and he damn near burnt the thing out (they are not built to run for hours on end). Anyway I wanted to have a go so I built my own forge, and this is how I did it:-

The Forge

The trick with designing a charcoal burning forge is that you want enough air to be forced through the burning charcoal so that you achieve the desired blast-furnace type effect and the associated high temperature, without spraying out burning charcoal over you, the kids and the dog. What you want is the right volume of air, without so much pressure that you get a burning charcoal fountain.

To do this we take a wide, comparatively shallow container to hold the charcoal (in our case the truck brake drum) and insert in the bottom a wide tube (called the oddly named “tuyere” which is pronounced “tweer”) The tuyere has a removable bottom to let the ash and clinker out, and into the side of this wide tube a narrower tube is inserted to take the air from the draft source (in my mate’s case the vacuum cleaner). Originally the draft source would have been a double acting bellows, but I used an old two speed blower from a car heater.

The air is forced by the blower or whatever into the smaller tube. Once it is directed into the larger tube the volume stays the same but the pressure drops, and with a bit of fooling around you can get the draught just right – lots of heat, but no fountain!

So much for the theory

The truck brake drum that my mate used was about 300mm in diameter and about 150mm deep, with the metal being around 6mm thick. It was big enough to do the small stuff we wanted to (with a bit of modification) and you could lift it up with one hand, so it seemed a good bet for me. I was working around truckies in the chemical industry at the time so I asked a guy I knew if he had any clapped out brake drums. He said he had and was happy to give me one. He dropped it off about a week later and boy, did I get a surprise! The brake drum was 420 mm in diameter and about 160mm high but what surprised me was the thickness of the metal, the bloody thing was 15mm thick steel and weighed a ton!

There was also a whacking great hole in the bottom where the hub was, as well as the holes for the bolts that hold the wheel on; so my first job was to put a cover over that, but leave a big enough hole to fit the tuyere in. Because it was available, I got hold of some 6mm steel plate and using an oxyacetylene torch cut a disk about 220mm in diameter to blank off the holes in the brake drum; then cut an approximately 80mm diameter hole in the centre to fit the tuyere. I then welded this plate over the bottom surface of the brake drum using a stick (or arc) welder.

I then cut a 46mm hole in the side of the 80mm tube I was going to use as the tuyere, and welded a 180mm length of 46mm tube (that I would use to introduce the air draught into the forge) into the hole. After that it was a simple matter to weld the 80mm diameter by 190mm tuyere and side tube assembly into the 80mm hole I had cut into the bottom of the 6mm plate in the bottom of the forge. I then used the 80mm diameter blank which I had cut from the middle of the 6mm plate to make a cover for the bottom of the 80mm diameter tuyere. This meant that the air pumped in by the blower would go straight up into the bottom of the forge and not be lost out the bottom of the tuyere. I did this by welding on some lugs to the plate and the tube to form a hinge, allowing me to open the tuyere and remove ash when necessary.

To stop the charcoal from falling straight down the tuyere I cut some lengths of 10mm diameter steel rod to go over the top of the tuyere to act as a grate, then welded them in place with the arc welder. The volume of the forge is quite large and to get a good fire going I needed to put a lot of charcoal in the bottom; so to make up for this I lined the bottom of the forge with clay dug out of the backyard. This formed a funnel starting at the top edge of the forge and sloping down toward the grate in the centre of the forge body. This meant that the air draught got to more of the charcoal and made it easier to keep the fire going, while using less charcoal to fill up the forge body.

The Draught

With the forge itself now largely complete, I needed to have some method of introducing a blast of air to the burning charcoal. Classically this would have been done by huge double-acting bellows powered by the blacksmith's apprentice, or on smaller forges a hand powered rotary fan. Seeing as I had neither, I had to design and build something else.

I wanted something that would work with the 12-volt system, so the obvious source of raw materials was a car wrecker. We had one in a nearby industrial estate, and I was

able to get hold of a two speed car heater fan quite cheaply. There was, however, no shroud around fan to direct the air flow in one direction, so I had to make one.

I was lucky that the original mounting flange on the fan was a reasonable fit for the opening of a 4 litre paint tin, so I got hold of a tin in reasonable condition - although some work was still needed, because a normal tin is usually 190mm high, whereas all I needed was 100mm to accommodate the fan. Using tin snips I cut the closed end off at the 100mm mark, then cut the open end off with about 20mm of the tin left on. Then mainly by hand I forced the open end into the closed end, and finally soldered the two together to make what looked like a paint tin 100mm deep.

This made the main body of the shroud, but I still needed an air inlet and outlet. Because this particular fan was a centrifugal type, the air intake would be in the flat face of the bottom of the "tin" and the outlet would need to be around the circumference. The air inlet was easy; I marked out a 50mm hole in the centre of the bottom of the tin and, with a small drill, drilled holes around the line I had drawn, allowing me to punch out the metal in the centre. I then peened over the jagged edge of the hole with a ball pein hammer to give a smooth surface that would not cause cuts. To regulate the air flow I fixed the top of a dog food can over the hole with one screw,

so that it could be slid over to cover anywhere from a small part of the hole to almost all of it.

The air outlet was a bit more difficult because I needed the air to be coming out a tube slightly smaller than the steel tubing on the forge that led into the tuyere. This would allow me to just slide the narrower tube into the larger tube, then power up and have air piped in with a minimum of fuss. I rolled some thin sheet steel I had hanging around into the form of a tube, drilled and pop riveted each end to stop it coming open, then soldered along the join to make the tube stable. I made a hole in the side of the shroud using the same process I used to make the air intake hole (drill and push out), slid the pre-made tube in and then soldered it in place. That way, when I powered up the fan I got a variable blast of air coming out of the fan and straight into the tuyere.

With a forge you can take waste and off-cut steel and turn it into all sorts of useful objects and hopefully if you have a mind to, this article will help you construct your own forge. An anvil is also a great help when doing a bit of blacksmithing and there is an accompanying article in this eBook on how to make one of those as well.

Installation

There are some things you just can't rush! I built the forge described above out a truck brake drum about 35 or so years ago, and since then it has been in a number of 'temporary' set ups, but it was originally destined for the garage. Not long after I built the forge I put together a brick support for it (mortared in – it ain't moving!) but because I needed to put a hole through the garage roof to install the flue, it never really happened. So, after 35 years, why now?

Funny you should ask.....

Not that long ago I was driving home from my daughters' place and saw a combustion stove flue kit outside someone's house for disposal. It went into the back of my car nicely! Then I was talking to a mate about getting hold of a steel 200litre drum to use as

a shroud over the forge, and he had a few so he gave me one. Finally we decided to have a blitz at our place by Permaculture Sydney West, and I would have all the help I needed to install it, so all of a sudden I was good to go!

The perennial problem about a leakless penetration through the roof of the garage was also solved by finding out about the Dektite roof flue flashing, which enabled me to put the flue through the roof without causing a deluge next time it rained. More on that later!

So with everything in place, construction could begin –

The Shroud

The idea of the shroud is to guide the smoke and heat up from the combustion area in the forge towards the flue and then on outside, thus preventing the garage (and my lungs) from filling up with smoke and crap. We started with a 200litre steel closed head drum which was in reasonable nick for having been stored outside for a while. It was easy enough to remove the top of the drum (the end with the bungs in) with an angle grinder, this surface would rest atop the forge body.

The second part was a little more complex and required drawing an ellipse on the side of the drum with the wide part toward where forge would be and the narrow end towards the top, from which the chimney would be fixed. The size of the ellipse is a trade-off between allowing enough area to work and enclosing enough area so not to allow too much smoke and fume to escape. The apex of the ellipse is only about 8cm from the top of the drum, and I think it may have gone a bit too high, and if use proves me correct, I may have to put a bit of sheet metal over the top of the ellipse to cover it in a bit.

To make the elliptical cut out of the drum was, again, just a process of drawing the proposed line in with permanent marker and cutting it out with the angle grinder. There was a bit of a complication though, in that the operator (ie me!) would be working right next to the cut metal edge, and all the opportunities for head or hand gashing that that would entail. To sort that out my friends Andrew and John, who was the craftsman at this point, bent the cut metal edge over on itself to form a safer edge using a pair of pliers and a hammer.

An OOPS Moment!

While this more or less finished the shroud, another issue had sprung up. It was my intention to take the flue up from the back of the shroud at 90° to the top of the shroud, right through the top of the garage roof to provide a vertical flue or chimney. That was what I wanted when I built the brick base, but as mentioned earlier, that was

over 35 years ago and things had changed! On top of the garage roof was now a part of our solar panel array and as luck would have it, the western end of the array ran right over the top of the space where the chimney was to emerge!

There seemed to be two possible remedies to this problem (apart from throwing our hands in the air and just going to lunch), the first one being to take the chimney at an angle out the back of the shroud, through the side of the garage and then up. The second way of doing it was to run the chimney off the top of the shroud as originally intended but at a 65° angle towards the west, so that it emerged from the roof at a 65° angle rather than the 90° angle I had originally intended. After much discussion it was decided that the first way had too many issues (requirement to construct or buy and angle piece for the chimney; the side wall of the garage contains asbestos) and compared to the problems with the second alternative (it looks silly), the second one won!

The shroud was then placed on top of the forge and the installation of the chimney began.

The Flue/Chimney

The first action was to cut a hole in the top of the drum to allow the smoke and hot gases to enter the flue. The diameter of the inner section of the flue was 110mm so that was the size of hole to be cut. Due to the small diameter of the hole an angle grinder was not suitable so we decided to use a nibbler. A nibbler is a is a tool for cutting sheet metal, operating much like a punch and die, with a blade that moves in a linear fashion against a fixed die, removing small bits of metal and leaving a kerf approximately 6 mm wide. The pieces of metal removed are half-moon shaped with two sharp points, they are quite small and as such can get into all sorts of interesting places, especially if you are operating the nibbler above yourself.

The nibbler is operated by being clamped into the chuck of a drill, the drill then driving the nibbler to remove the metal. You just drill a hole in the metal to be cut, insert the nibbler and press the trigger of the drill – then you cut! The nibbler made short work of the hole in the top of the drum. To make things easier the hole was not cut at the rear of the drum, but at the very right hand side (western end) of the shroud to reduce the angle required to ensure the chimney emerged well away from the solar panels.

The next thing was to work out where the chimney would emerge from the roof and using the nibbler, cut the hole. The hole through the roof needed to take not only the inner flue but also the outer flue casing as well, which was 180mm in diameter, so we cut the hole around 200mm in diameter. We cut the hole in the roof as close to the solar panels as we dared (using the nibbler again), then slid the flue in through the hole until it made contact with the top of the drum (shroud) where the hole was.

With the hole in the roof and the shroud now in place, it was time to insert and fix the bottom part of the flue to the top of the shroud. This was accomplished by making small cuts in the end of the flue using the angle grinder, bending them out to the appropriate angle and then screwing the end of the flue down onto the top of the shroud.

With the inner flue secured it was a (comparatively) simple matter to slide the outer casing down inside the roof over the flue and then secure it to the shroud so that here

was an air gap between the two to provide some insulation. We secured the outer casing by cutting some triangles of metal out of the end of the casing to form tabs, bending the tabs to the required angle and screwing them to the top of the shroud as well.

With the lower section of the chimney now sticking out of the garage roof at an angle, we fitted the Dektite seal over the top of the chimney and pulled it down onto the roof. We then fitted the top part of the chimney and the chimney casing over the part exiting from the garage roof. With the chimney fully in place it was secured by applying (lots of) silicone to the underside of the Dektite and then screwing it down to the roof of the garage. I waited with bated breath for the next heavy shower of rain, but when it came there were no leaks whatever, so the operation was a success!

Connecting the power

The only thing left to do before the forge could become operational was to fire up the blower. The blower was out of a car and so ran on 12 volts DC, I needed to get power from the board on the other side of the garage. Fortunately there were some redundant wires that I was able to repurpose to provide power to the blower. I wanted to be able to operate the blower with a foot switch, so I picked up a new foot switch and wired it in. It is rated for 220v but seems to do the job pretty well.

So now we are right to go!

2.6 Making a Sheet Metal Bender

While reading and old book on sheet metal work, (How to Work Sheet Metal by H.J. Dyer, first published over 75 years ago), I came across a bench modification for folding sheet metal. The idea is simple, based on a piece of angle iron, let into a bench and a length of flat steel strip bolted to it. I made mine on a much smaller scale that the one recommended, but I only used materials that I had on hand, and it works well for me.

Construction details

The first thing to do is work out the size that you want. It may be anything up to the full length of the bench. Mine is only 2/3 as long as the bench or 850mm (33in). Once your angle iron and steel strap cut to length the angle iron needs to be let or recessed into the bench.

I used 25mm x 25mm (1 x 1 in) angle iron about 6mm (1/4 in) thick, so I did not need to remove a lot of wood. A power router would be the quickest, neatest way to remove wood from the bench. I don't have one so I used a mallet and a 25mm (1 in) firmer chisel. I may be basically destructive but I found it good therapy pounding away with the hammer and chisel. Also, my bench is pine and not too heavy going.

Once the angle iron site flush with the top and front of the bench it can be secured with wood screws. I drilled 3 holes for each screw, the first was a pilot hole through the angle iron and wood large enough to allow the screw to bite. The second (on the same axis) just through the iron to allow the shank to pass. I then topped it off with a large drill to give enough countersink so the screw heads would sit flush. This is especially important on the front of the bench.

I used 25mm x 8 gauge wood screws on the top (5 off) and 50mm x 8 gauge wood screws (6 off) on the front face.

The angle iron is now secured and sitting flush with the bench and it is time to drill clearance holes in the steel strap and tapping holes in the angle iron. (for the front piece I used 37mm x 6mm steel strap).

The next decision is what size bolts to use. You need to have a few (I used 10) the same size, and a tap the right size to thread the holes with. I used 5/16" Whitworth bolts (18 threads per inch) because I have a stock of them and as luck would have it, also a tap that size.

After marking out the steel strap and putting a centre punch mark where the holes were to be drilled, I clamped the strap onto the angle iron in the position it was to occupy when it was finished. I then drilled pilot holes through the strap and the angle iron (3mm diameter) so any subsequent enlargements would line up.

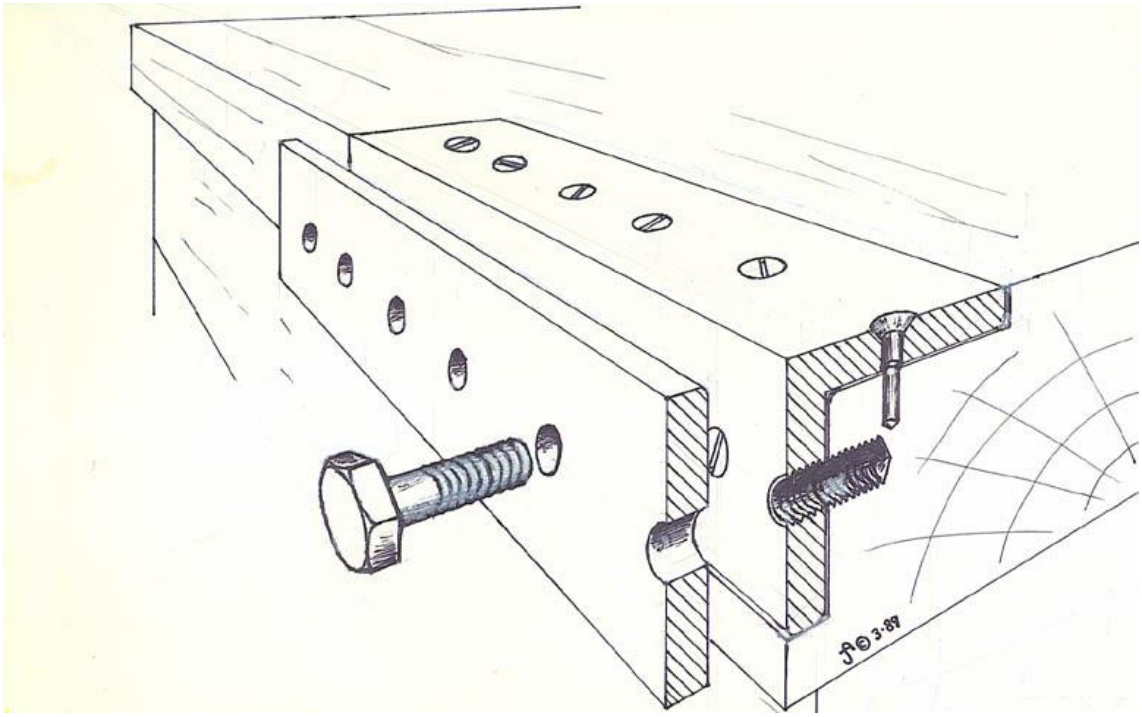
Removing the steel strap I drilled the clearance holes in it to allow the bolts to pass through without binding. This happened to 8 mm diameter. A drill press helps here to ensure that the holes are at 90° to the face of the iron, although it is not essential.
I then ran into technical difficulties when I cam to drill the angle iron for tapping . According to the chart that I have for such things, the correct drill size for a 5/16" Whitworth tap is size "F" (what the hell?). Not having one (or even being sure where I could GET one!) I had to use the closest I had which was 17/64" diameter (slightly oversize). The finished hole when threaded is a bit loose but OK. So could then finish tapping out all the holes. I do not come from an engineering background and tapping threads into holes in metal is somehow satisfying to accomplish, maybe it's just me! It is quite simple to do but a bit difficult to describe, and competent fitter/machinist/ boilermaker can show you how.

All that is required then is to bolt it together and see if it fits. The left hand end bolt was binding a bit, but drilling out the hole in the strap to the next size up fixed the problem.

You use the folder by removing enough bolts to allow the metal you wish to bend down to fit between the angle iron and the strap. The remaining bolts are then tightened up and the metal bent over using your hands, a lump of timber used as a former, or judicious application of a “gentle persuader” (hammer).

It took me five hours to put together. The only specialized bit being the tapping of the holes, which is dean easy when you have the right gear. I have folded sheet steel up to 1mm thick in this machine with little problem.

Just recently, I made up a reflector oven to go in front of our open fire using the folder and it performed flawlessly. (the oven was used to cook up a chook to perfection!). It is one of those tools that enables you to do work that otherwise would be very difficult or impossible without access to a metalworking shop. Happy folding!



Materials and sizes

Angle Iron

I used: 25mm x 25mm

Recommended by the book: 2 ½" x 2 ½"

Steel strap

I used: 37mm x 6mm

Recommended by the book: 2 ½" x ½"

Wood Screws

I used: 25mm x or 50mm x 8 gauge

Recommended by the book: 2 ½" x ¼"

Bolts

I used: 5/16" Whitworth

Recommended by the book: ½' Whitworth.

2.7 Making a Small Hydraulic Press

I was doing some work in the garage some 20 odd years ago and realised that I needed to be able to apply pressure to install and remove bearings as well as press out oil and/or perhaps grape juice, bend metal and a host of other things that need the application of pressure over a small area. I decided I needed a press and that the cheapest way was to build one, so I took my welder, bench drill and other tools in hand, not to mention a modicum of steel I had put away and proceeded to construct one. Before getting stuck into things it is worth noting a couple of points –

1. This is the way I did it, using available materials. So if you are intent on making a press too, look at the principles involved before ordering 3000tonnes of mild steel, and

2. The press is very over designed when used with a 10 tonne jack, but the steel was what I had on hand at the time.

The press is made up of the following parts –

A. Two uprights made from 150mm x 75mm mild steel channel

B. Two spacers used at the bottom to separate the uprights made from 64mm x 25mm angle iron

C. Two “feet” to stop the press from falling over during use, made from 75mm x 75mm angle iron

D. The table on which the work to be pressed sits, was made from two lengths of 50mm x 100mm mild steel channel joined by two lengths of 25mm x 25mm angle iron.

E. The pins on which the table sits which are made from a length of 16mm diameter steel bar

F. The moving member which does the work (ie it moves down and applies pressure when the press is in use) which is made from 50mm x 100mm channel with 25mm x 25mm welded on top to stop it flopping about, and a lump of 50mm steel bar welded onto the bottom face that applies the pressure.

G. The top brace against which the jack pushes, made from 100mm x 100mm steel RHS

H. The bit what applies the pressure, which will be discussed in more detail later.

All the cuts were made with an oxyacetylene set and the rough ends cleaned up with a 100mm angle grinder.

I made the press as follows –

The uprights (which seem to weigh a tonne!) were marked out drilled with a morse taper 13/16" drill to produce holes 150mm apart. These are to take the pins that support the table. I drilled one hole in each 75mm face of the upright so that the table sits flat on the pins when inserted in these holes once the press is assembled. I then marked out 10 holes down the face of the uprights to allow the table to be adjusted in height at 150mm centres using a centre punch and then drilled ¼" pilot holes with a hand drill. Next I levered the heavy uprights on their side onto the table of my bench drill and drilled in the 13/16" holes to take the pins (I'd hate to try that with a hand drill!). The 13/16" holes meant that there was an easy fit for the pins, but also, it was the only size drill I had that came close to being the right size, so you have to use what you got!

The ten holes in each face now drilled (40 in all) I could stand the uprights back up and bolt on the top brace to the top of the uprights using a plate I had previously welded across the open part of the top of the channel. I used 4 x 12mm bolts on each side – it wasn't going anywhere! One the top brace was on I wrestled to keep the uprights, upright and at 90° to the floor while I welded the spacers in place at the base of the uprights. The 75mm x 75mm angle iron "feet" were then welded on the bottom to keep the press superstructure straight and upright.

The next step was to insert the pins into a set of holes and place the 50mm x 100mm channel on them, on its side to form the working part of the table. I welded 25mm x 25mm angle iron onto the ends of the channel, outside the uprights so that the table formed a box around the uprights that was hopefully level and stable but still moveable.

The moveable member then needs to have the 50mm diameter steel bar (the bit that does the pushing) welded to the moveable member. I only have a stick (arc) welder so I got a mate who is a welder by trade to weld it on with MIG because it is a bit difficult to get to inside the channel. That done I welded on some of the 25mm x 25mm angle iron on the end of the channel so that they curve around the uprights and keep the moveable member steady. Once fitted into the uprights I suspended it from the top brace using two large springs held onto the 100mm x 100mm RHS top brace and moveable member with cable clips.

The springs are a story in themselves, I spent quite a bit of time trying to find off the shelf springs that would be strong enough to support the moving member and the hydraulic jack without being so tight as to prevent the jacks' correct operation. In the

end I found a local spring manufacturer in the industrial estate that I was working at the time and explained what I wanted to do. The custom made me two springs that were perfect, for only $10 a piece, although that was 20 odd years ago and they might cost a bit more now.

Now comes the bit that does the work the hydraulic bit that applies the pressure and turns a large lump of metal into a functioning press. There are three types that could do the job –

1. A conventional hydraulic jack, similar to the bottle jack you would use to change a tyre on your car.

2. An upside-down hydraulic jack

3. A hydraulic ram and pump like a Porta Power or similar

The conventional hydraulic jack is cheap, easily available and versatile. It can also be used to jack up vehicles in its spare time. The upside-down jack is more expensive and virtually useless for anything else but, when mounted directly on the top brace, it would allow you to do without the moving member and springs by applying the downward force directly. The hydraulic pump and ram are used commercially in hydraulic presses, they also allow the moving member to be done away with and are very versatile, but even a second hand one can cost three time the price of a new jack of the same pressure.

Needless to say, I chose option 1, but rather than just buy a jack I bought a hydraulic pipe bender at a approximately twice the cost of the jack. This gave me two tools I could use and a jack that can be used on its side (many hydraulic jacks can't be) so I can build it into a homemade log splitter, when I get the time. Mind you I have had the thing for over 20 years and the log splitter hasn't materialised yet! But I do still have a very versatile hydraulic hand operated power source. Considering my likely uses and current costs I chose a power plant with 10 tonne capacity, but it was personal choice.

The press was completed just a few days before one of the bearings in my car alternator very noisily gave up the ghost. Instead of having to buy a new or reconditioned alternator I dismantled it, pressed out the old bearings and pressed in the new ones. At $12 for the pair it was a cheap repair job, giving me an almost new alternator, so the press had started to pay for itself already.

2.8 Tools and Gear for Repairs and Maintenance

It is more mundane than solar power, water tanks and food storage, but it is very important to have the tools and equipment to enable you to maintain your house and machinery. Some aptitude for mechanical work is a good thing to have but most people can perform minor repairs such as changing a tap washer or adjusting the spark plug gap on the car with the right tools and a little instruction.

A place to store tools, spares etc and a place to work makes things so much easier so a garage or garden shed will be a distinct advantage. If you are pressed for space and do not have such facilities there are other ways to set up a work area. At the risk of raising the ire of the lady of the house, the kitchen table can be converted to a work bench (temporarily of course!) fairly easily.

The single most important point to remember is that cheap tools and fittings are false economy. Where possible, buy only Australian, British, American or German tools, although some Japanese tools are of reasonable quality. Second hand tools can also be of good quality and are always worth a look, especially if they are going cheap.

Workshop Facilities

Lighting

The area should be well lit by natural or artificial light. Some artificial light in necessary so work can be carried on at night, bearing this in mind 12v lights, brackets for candles or kerosene lamps or gas lighting should be allowed for when the area is being designed.

Work Bench

This is one of the most important items in a work area. It should be sturdy and solidly braced so it will not collapse when it is hammered on or planed against. A very heavy work bench can be made from sleepers mounted together and held up by a steel or wooden frame. A previous section of this eBook covers the manufacture of the workbench illustrated below. Portable benches such as the "Bathurst" style folding bench are quite good for most jobs and even the "workmate" style is better than nothing.

As mentioned earlier the kitchen table can be converted to a bench by making up a 25mm thick piece of particle board or plywood (plywood is better but more expensive) the size of the table top. On one of the longest sides of the bench top an edging should be secured which goes down over the edge of the kitchen table, this is the side you work from. The top and working side of the kitchen table is protected and if the opposite side to the edging is clamped down to the table (using "G" clamps) a serviceable work bench is produced. Vices may be fixed to the working side of the worktop to increase its usefulness. The underside of the bench top should also have a felt lining to prevent scratching the table.

Power

Normal 240v power points should be located in the work area so power tools can be used when electricity is available. A lot of time and effort can be saved by having a few power tools say, a hand drill, bench grinder and perhaps Orbital sander. Of those the most useful by far is the hand drill so if you are going to set up a 12vDC system it is worth buying a 12v drill, it will make things much easier when the power goes out.

Tool Storage

If space permits the peg board or shadow board is the best method of tools storage. All tools are visible at a glance, it is easy to see if one has not been replaced and when you need a tool you can walk up and take it without spending half an hour looking for it. The tools also remain in better shape. chisels are not blunted rubbing against files, files do not clog with dirt, saw do not damage tool handles or blunt themselves, as they do when jolted around in a toolbox. If a tool is getting a bit rusty it can be seen immediately and attended to.

Some tools in boxes eg. planes, socket sets, screwdrivers or taps and dies may be more easily stored on shelves or in drawers so some allowance for this type of storage should also be made. If you do need a travelling toolkit the tools are best kept in a cloth or plastic tool roll. this can then be stored in the toolbox. In a tool roll the tools are kept separated, and are protected but are easily accessible and portable.

TOOLS

Hammers

For woodwork a claw hammer and mallet are essential, for metal work medium size ball pen hammer is needed and for general work a l.5 kg club hammer is required. In the "nice to have" category are - several rubber hammers, a soft face hammer, a tack hammer, cross pen hammer and a sledgehammer.

Chisels

A set of four good quality firmer chisels cover most requirements (6 mm, 12 mm, 18 mm, 24 mm wide) a mortice chisel or two are good for heavier work and chiselling out mortices for mortice and tenon joints in wood (funny bout that). A cold chisel or two for cutting metal drums, sheet etc is also a good idea.

Planes

An all-purpose jack plane is all that is necessary for most jobs. A small block plane is very handy for small jobs and a spoke shave is good for irregularly shaped work.

Saws

A tenon saw, rip saw, crosscut saw, (or combination rip/crosscut) will handle most wood jobs but a hacksaw is necessary for metal cutting. Spare blades are required for the hacksaw as they are very difficult to sharpen and tend to break. To keep your wood saws in trim it is advisable to have a triangular saw sharpening file and a saw set to maintain the angle of the saw teeth to the blade. This prevents the saw binding in the cut.

A remarkably handy all-purpose rough work saw is the bush saw, they are ridiculously cheap and very versatile being at home with pruning, fire wood cutting or rough carpentry work. There should be room in any self-reliant persons' tool kit for a bush saw and spare blade.

Screw Drivers

A full set of slot and Philips (cross) head screw drivers is available for a reasonable price, produced by Stanley, from most hardware stores. The quality of steel in cheap screwdrivers is immediately obvious when you go to use them, and they bend like case hardened chewing gum!

Twist Drills

I only buy "Frost" brand drills, they are excellent quality, Australian made and reasonably priced but can be hard to get. A full set from l/16" up to the size of your drill chuck (usually 3/8" or l/2") can be bought as a set or one at time. A set of frost masonry drills is also worth investing in.

Spanners/Sockets

A set of open ended/ring spanners metric or imperial depending on what type of car you have Japanese/European or Australian/American/English is worth investing in. Also a set of 3/4 inch or half inch drive metric/imperial sockets is a valuable set of tools if you intend working on cars, bicycles or lawn mowers etc. A lO" and a 6" shifting spanner (or "shifter") are versatile tools when used properly, they can damage nuts if used improperly.

Measuring Tools

The following are a good basic set of measuring tools -

- One x 3.5 m tape measure
- One set of metric or imperial feeler gauges
- One x 30 cm stainless steel rule .

Nice to have are -

- One set of inside and outside callipers - 150mm long
- One x 1 metre stainless steel rule
- One folding wooden rule
- One set of vernier callipers .

Marking Tools

- A carpenters pencil or two
- One steel scriber
- A marking gauge used for marking out mortices on wood

Pliers

A set of solid, square nosed crescent pattern pliers 150 to 250 mm long is a good start as they are very versatile, along with a set of long nosed and side cutting pliers make a good basic kit. Nice to have are slip-joint pliers, vice grips, circlip pliers and a set of multigrips. Working in a similar manner but not strictly pliers are a set of offset tinsnips and bolt cutters, both worth having.

Files

These are handy for shaping, smoothing, de- burring, enlarging holes etc. For a basic kit a 250 mm half round second cut, bastard and smooth file plus a rasp will cover most situations. A round file, three corner file and square file round out the kit.

Vises

There are two basic common types - the all steel engineers vice and the wood faced carpenters vice. They are measured by the size of the saws ie. a 6" (300 mm) vice has jaws 6" wide. A good allpurpose engineers vice is a 3" (150mm) but for heavy work a 5" (125mm) or 6" (160mm) is needed to absorb the energy of hammer blows without breaking. A wood working vice with 6 - 8" jaws is the most versatile for carpentry use.

Holding Tools

Known as "clamps" in metalworking and "cramps" in woodworking, these tools allow us to hold work together so we can join, screw, glue, sand, weld, paint, fix and generally work on. If you work by yourself without an assistant, you can't hace too many clamps/cramps. There are G-clamps, C-clamps, mitre clamps, pipe clamps, spring loaded clamps, specialy clamps; you name it, it's out there. A good selection of different sized G-clamps is a good place to start and a few (even el cheapo) spring loaded clamps can get you out od a tight spot. I just picked up 5 second hand mitre clamps and have found them useful for making cupboards and boxes as well as picture frames.

Sharpening Stones

A 150 mm long rectangular combination bench stone will keep most edged tools like chisels and planes sharp. A circular combination axe stone is good for axes and other garden tools.

Welding

The facility for welding in a workshop greatly extends the variety of work you can do. It enables you to join thick pieces of steel, rebuild worn parts, patch holes in metal and build metal structures which are strong and secure. It is a skill which must be learned and is very difficult to pick up out of a book, but there are TAFE courses around which are very good , teaching both theory and practice. There are two types of welders in common use in the home.

a. Arc Welders - These come in a range of sizes and allow the handy man to weld steel up to 12 mm thick fairly readily. Rapid, cheap welding of various thickness of steel is the arc welders forte, and when you have bought your welder there is no other cost apart from rods. Arc welders do require electricity to run, petrol driven welder/generator sets are available, but they are bulky and very expensive. So in most instances when the electricity stops so does your welding. There is a booklet available from Trendline Publishing Co. GPO Box 1889, Sydney, 2001-which tells how to build a portable welder from a car alternator. If you are interested this would be one way of welding without 240v electricity.

b. Oxy - Acetylene Welding - This uses the heat of the oxy acetylene flame to melt metal and filter rod to form a joint. They are very versatile allowing metal to be cut as well as welded. It is easier that Arc welding and non-ferrous metals eg. copper and brass can be welded and brazed as well as steel and cast iron. oxy acetylene uses cylinders of compressed gas and no outside power sources are required, but the cylinders are only able to be rented. So even if it sits in your garage for 6 months at a time unused it will still cost you a yearly rental fee. Also to weld thick steel is expensive in terms of time. effort and gas, but all in all if you want to weld and can only buy one set of equipment, make it oxy acetylene.

CONSUMABLES

Lubricants

- Engine Oil - you need sufficient for 1 oil change for the car plus any small 4 stroke motors eg Generator, lawn motor, rotary hoe etc.
- Machine Oil - 2 - 3 bottles of light machine oil for bearings, squeaks , to lubricate sharpening stones etc.
- All Purpose Grease - A 2 kg tin would be enough for most uses.
- H.T. Bearing Grease - 500 g for wheel bearings
- WD-40 or equivalent - 2 TO 3 cans or 1 litre of the liquid and a spray gun.
- Graphite - To be used where grease or oil picks up dust or and makes the problem worse - 1 bottle .
- 2 Stroke Oil - For use with unleaded petrol if you have any 2 stroke powered machines eg Chainsaw or motor mower.

Tapes

- PVC electricians tape - Mind bogglingly useful stuff for sealing, joining and generally holding things together. Can be used on electrical gear too! Keep 10 rolls.
- P.T.F.E. (Teflon) tape - A plumber on a roll! useful when sealing threaded joints especially on plumbing - 2 to 3 rolls.
- Reinforced Repair Tape - Good for patching up holes in all sorts of things and holding things together, it is a full 50mm wide. 2 to 3 rolls.
- Masking tape - Comes in 22 mm, 25 mm and 50 mm width 2 rolls of 25 mm is handy.

Glues

- PVA - is a very useful wood glue although it is not waterproof. A 1 litre bottle is handy.
- Epoxy - (eg Araldite) - Good where a rigid joint is required, it forms a strong bond. Two tubes each of glue and hardener.
- Contact Cement - Good for gluing rubber, plastic and other flexible surfaces. Two 500 ml tins.

Fasteners

- Screws - 1 box each of 5/8", 1", 1.25", 1.5", 2", 2.5", 3" long.
- Nails - These are best bought by weight as mixed nails from hardware sections of department stores or from hardware stores.
- Nuts and Bolts - A wide selection is advisable but 1/4" diameter Whitworth bolts of varying lengths are very handy.
- Hinges - a variety .
- Hooks and Eyes
- Coach Bolts - 25 mm, 50 mm, 75 mm, 100 mm, 150 mm long.

Spares

It is impossible to keep all the spares that you might need for a long period of disorder. But the more bits and pieces you can salt away the easier you will cope with problems as they arise.

Bicycles

Parts for bikes are readily available now and fairly cheap, and bikes may be the transport of the future when the petrol runs out so stock up now.

- Bearings - 1 pack of each of the major ball bearing sizes - 5/32", 3/16", 1/4" and 5/16". 1 head set bearings and seat.
- Tyre - 1 per bike
- Tyre Tubes - 1 to fit each bike plus spare valve and puncture kit.
- Brake Shoes - 4 per bike
- Cotter pins - Two per bike if applicable
- Spokes - 2 or 3 to fit each bike (plus spoke key)
- Axle - 1 front axle per bike complete with bearing caps
- Chain - 1 per bike

Lighting

- 1 Glass and wick for each hurricane lamp
- 1 bulb and batteries for each torch
- Candle wicking for making candles

Plumbing

- Leather and fibre tap washers
- 50 mm PVC piping for modifying drainage lines plus fittings and cement
- Yorkshire fittings for repairing water lines

Building repairs

- Hardwood for shoring up walls.
- Tarpaulins and black plastic rolls for covering damaged roofs
- Extra roof tiles
- Extra bricks
- Cement in bags
- Acrow props
- Corrugated iron sheets

3.0 Hand Tools

Please note: I have done my best to reproduce the "cuts" that Bill used as his illustrations but I am dependent upon the quality of the original printing, which was somewhat variable. Colour photos were taken by myself.

3.1 Files and Rasps

Of all hand tools, files must surely be the most varied. For each trade certain files have been adapted to certain requirements. Thus, gunsmiths developed files that differ from those used by engineers or clockmakers. While this may cause some confusion at times it does mean that one can find to suit almost any purpose.

In the past when looking at tools I have recommended the purchase of second hand tools wherever possible. This is an exception to that rule. I have rarely ever found any good second hand files, and wouldn't waste my money. New ones are chap to buy and you wouldn't be saving much.

Flat files are the most widely used by the average home handyperson. They come in two basic forms and three basic grades. To amplify upon that statement:

Teeth may be cut as shown in the illustration below. Here we have a single cut file. The teeth are cut at an angle to the edge and are parallel for the full length of the body.

Below is a double cut file. In this instance a second set of teeth have been cut at an opposing angle. This produces diamond shaped teeth.

The number and depth of the teeth will fit into three grades. Where teeth are large and coarse, the file is a “bastard” file. When somewhat finer, it is a “second cut” file. When fine and close together the file is a “Smooth”. These grades may be found on files from about 15cm up to about 60cm long.

In addition you can buy files that are smooth along an edge (safe edge) or even a face. When toothed, an edge may be either flat or curved. As I said before, each trade has developed special purpose tools.

In addition to the normal flat or hand files, one can buy half round files (flat on one side, curved on the other), square files (square in section), round (or rat tail), these may taper as in a rat tail or be parallel for sharpening chain saws or triangular (triangular in section – as in a saw sharpening file). There are also combinations and variations to these basic shapes. You may find oval shaped files, diamond shapes etc.

To use a file properly is not difficult, but it takes care and thought. Files should only be pushed across the work. To pull a file back across the job will only hasten the wear on the teeth. Thus on should work slowly and methodically; push the file across, lift on the backstroke. Try and adopt a mechanical stroke of even steady rhythm. This is far more productive than frantic sawing at the workface. Use sufficient pressure on the tool to make it cut into the work. A file that slides across the job will soon dull and there is nothing more useless.

Never try to file metal that is too hard. If the file won’t bite, look for another way – maybe grinding? Files are extremely hard but soon will become dull. This then leads to

a very good rule: If you can, keep new files for working brass. This metal requires a very sharp file. When it eventually dulls (and it will), then use it on steel. It will still be sharp enough for steel when it no longer cuts brass. One little trick of mine is to paint the end of one side. Keep the painted side uppermost until it dulls, then turn it over. This keeps one side keen for brass, and seems to prolong the working life of the tool.

Files can clog up when working on almost any metal. Clogging is called “pinning”, and will quickly cut deep scores along the work face. There are special cleaning brushes called file cards, which are used for unpinning a file. Being made from a hard steel they soon dull the teeth. I prefer to use a soft piece of metal which I pull along the line of the teeth. Alternatively you can use a bronze suede shoe brush to good effect.

Another trick is to rub a piece of blackboard chalk along the teeth. The chalk prevents the metal shavings from wedging in, but it also slows down the cutting somewhat. You can help prevent pinning in round files by rotating the file as you push. You can sometimes prevent it with hand files by changing the angle of the stroke.

Ideally one would commence a job using a bastard file, then switch to a second cut for cleaning up, and finish with a smoothing. Since you may not have a wide range to choose from, you can try draw filing to give a smoother finish.

To rough down, you usually file across the work. Draw filing is when you hold the file at both ends and draw it along the work. It is effective but can cause pinning so do it with care, and check the file frequently. Also, using chalk will slow the cut and give a finer finish.

If you have the opportunity, buy as many different files as you can. Also, never pass up the really big files if you can afford them. The longer the file, the quicker and easier it is to use. I'd far prefer a 50cm file over a 25cm file, all else being equal. They are easier to use and the extra length makes cutting much faster. Once you get used to a long file, you won't go back to the shorter ones for general work.

There days one finds uncommon files in the shops. I've found some really large and unusual ones recently, and they were well worth the purchase.

The illustration above shows and dreadnought file. These are suitable for both some materials such as brass and aluminium , and wood. Aluminium is particularly prone to clog files, and the tooth shape of the dreadnaught is a method of countering this. These files are also suitable for working plastics – particularly body filler and soft solder –, both of which are used in panel beating.

Another attempt to prevent clogging is the millencut, as shown below. Again this may be regarded as a transitional tool, being equally suited for soft metals as well as wood.

Files used in woodwork are called "rasps". Mostly they have individual pointed teeth as shown below left. They should never be used on any hard metal. The teeth will not stand up to that sort of abuse.

Because of the tooth shape and the differing characteristics of wood, rasps have very little tendency to clog. The only problem I've has been with a resinous timber. A bronze suede brush will soon fix that. If that doesn't clean up all the teeth, brush on a coat of mineral turps. That dissolves the resin.

While it is pretty much a last ditch remedy, you can resharpen files. The first step is to give the file a thorough cleaning, taking care to remove all grease as well as dirt and pinnings.

Pour a small amount of sulphuric acid into a plastic bottle top, and put both acid and file into a large plastic bag. The bag should be propped up to form an enclosed tent. After several hours the acid fume will have etched away the surface of the file and given it a red coat of rust. The file should be liberally wished with water and a paste of garden lime and water applied to the whole file. The lime will neutralise the acid. Wash off the lime and brush away any remaining rust before drying the file in the sun. Apply a coating of oil to the body of the file to prevent further rusting. After a day or two the oil can be removed and the file is ready for use again.

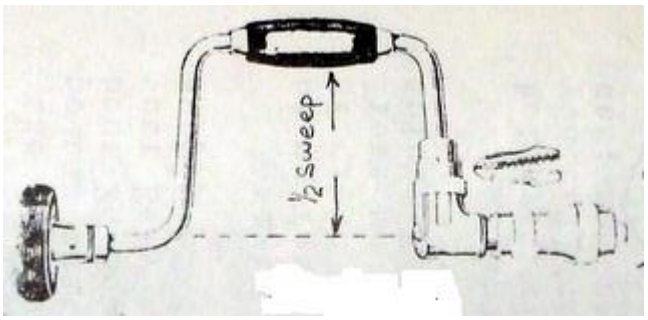
Oil on the file will prevent rusting but it also helps to increase pinning. I like to keep files oil free unless I have a particular requirement. After that, I wash off the oil and keep the file dry again. When draw filing you can rub chalk onto the body and put a couple of drops of oil on the chalk. This will give a very fine finish, but pinning could be a problem. Some metals are far worse than others, so try it and see what results you can obtain. At worst you can easily brush the chalk out and wipe the metal clean.

3.2 Drilling and Boring

In recent issues we have looked at a number of tools that may be found in second hand stores and markets. Continuing with the series, I would like to look at hole making tools. While such tools can readily be found as second-hand items, many are not a good buy. It has been my experience that many old tools are just that – old, but not necessarily much good. Many of the holes making tools fall into this class.
To begin with, we shall look at the driving end of the business. Broadly we can divide these into two classes:

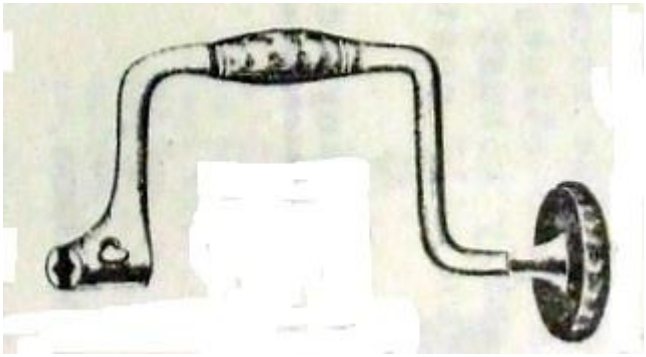
Braces

Braces are mechanical devices that grip a boring tool, usually referred to as a "bit". They work on the principle of leverage, defined as "sweep". Sweep is the amount of coverage of the handle, from one side of the circle it describes, to the other. Sweep usually ranged from 8" to 14" (200mm to 350mm) though this was back in the days before they got onto this metric rubbish.



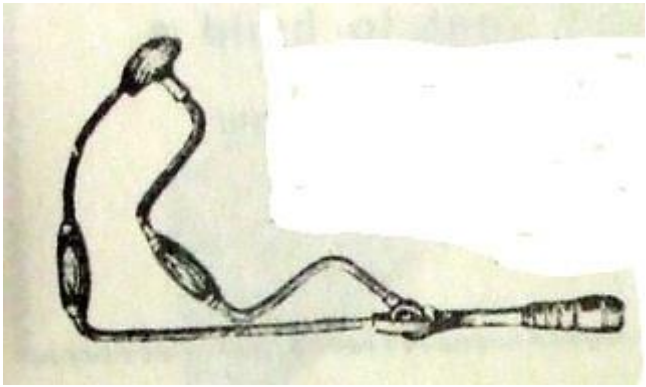
The most common kind of brace found these days is the ratchet type. By turning a ring on the crank, one can either engage, or disengage the ratchet pawls. This enables the quick boring of holes in confined spaces, makes driving screws easier and generally makes the brace more useful. Technically a ratchet brace would be weaker in construction that a non-ratchet version, but I've never known one to break so it would be a moot point.

When buying second hand braces, check how much wear there is between the Head (the wooden button top) and the crank. Frequently the head becomes very floppy. It would be possible to re-sleeve the head, but it may be easier just to look for a better buy. Also, check the wear in the ratchet and inspect the condition of the jaws. (the chuck will screw off anticlockwise and the jaws drop free).

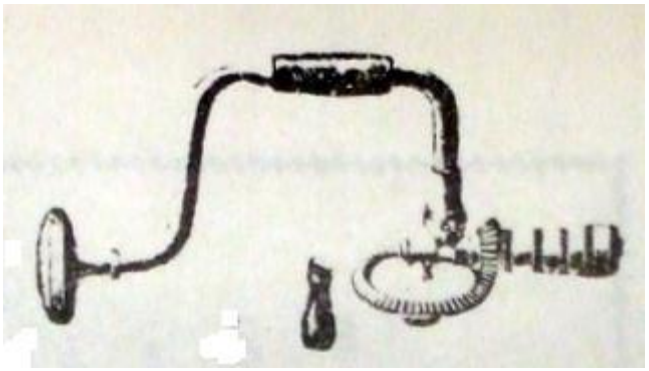


Ratchet braces have remained unchanged for about 100 years so i wouldn't go looking for an old one – just a good one.

On occasion one may find other and more unusual forms of braces eg the "Spoffords Pattern" shown above. While they are not so frequently seen, they are not rare and would not be worth spending much on, other than as novelty value. I have bought several, but only as examples of older tools.



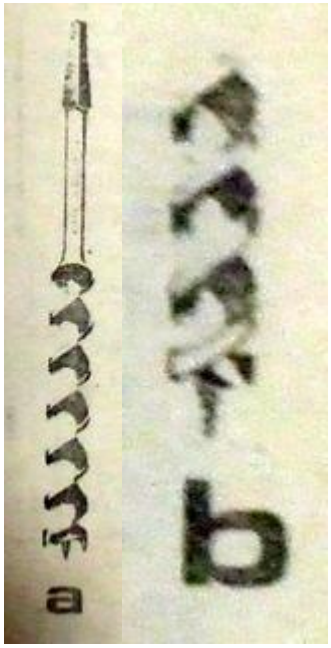
In the past, great minds sometimes spent years developing useless devices (have times changed?). The cut above shows a corner brace and one below is a combination drill and brace. I've never seen either, they came from a catalogue over 100 years old.



Bits

While one may only need just one brace, you will find a need for a number of bits. Luckily, the flea markets usually abound with them. Again, age is not as important as condition. While you can clean up rusty bits it is usually easier just to look for good ones.

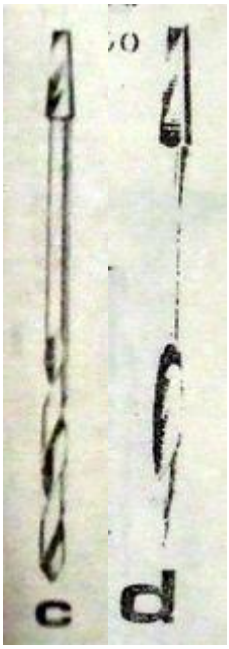
Cut ”**A**” shows the ordinary softwood auger, these will be found in two versions. A is the softwood and **cut "B"** shows the cutting end of the hardwood, the difference being that a softwood bit comes with a pair of “spurs” that scribe a circle in the wood, thus eliminating splintering and chipping at the start of the hole.



In hardwood, I like to start out using a “softwood” bit and then switch to the

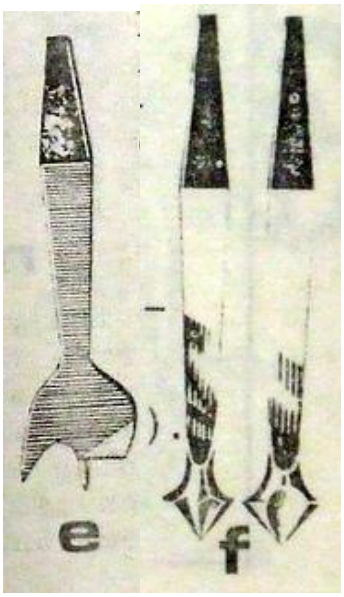
“hardwood” version. The spurs add to the load, and you can break a softwood bit if boring into very hard, dense timber.

Cut “C” shows the wood drill, they bore a clean hole of moderate depth, without fear of splitting the timber. They are not quite so common and really don’t do anything the auger can’t do. Worth buying if they are going cheap. Note that they are sharpened to a different angle to the ordinary twist drill and should never be used to drill holes in metal.



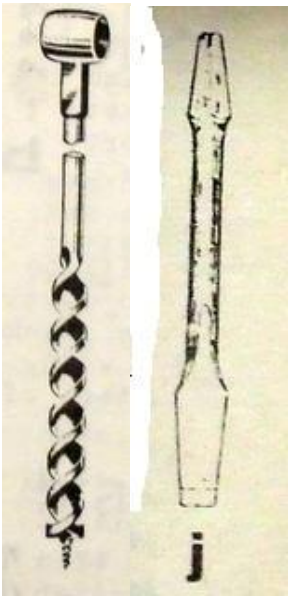
Cut “D” shows a nail or cobra bit. They were primarily used for quick cutting of small holes suitable for bolts or nails. They can tend to wander in the timber and may split the wood if used near the ends. The shape has a tendency to wedge the wood fibres apart. Useful – if you can find them in reasonable condition.

Cut “E“ shows a centre bit. These were useful for boring holes in thinner timber. The action of cutting is similar to the auger, but there are no guiding flutes to keep the bit drilling true. Holes will tend to wander off course. Still, they are easy to sharpen and quick to use so worth buying at the right price.



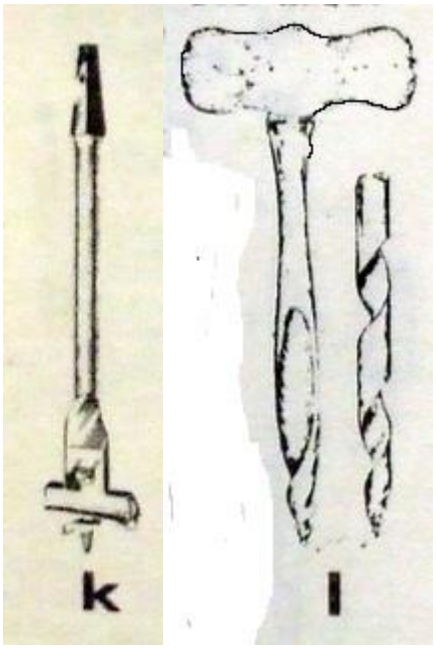
Cut "F" shows two countersink bits. These are used to open out the top of a hole to take a countersunk screw. For my money, the rose pattern (the one on the left) is better than the snail. It has more cutting edges and is easier to sharpen.

Cut "I" shows a long-handled augur. These are used to bore deep holes, sometimes more than a metre in depth. Instead of a brace, a crossbar is fitted through the eye. There are plenty of new ones on the market, at good prices – so don't pay much for an old one.



Cut "J" shows one version of a screwdriver bit. They can break and the metal may not be as it should be so buy several if you can. They are very useful for running in a large number of screws in a short time. BUT. They have a nasty habit of jumping out of the screw slot, which can put deep indentations in the timber. It is important to select a correct fit for the screw slot.

Cut "K" shows an expansion bit. With one of these you virtually have a toolbox worth of bits. The adjustable cutter can be set to the radius required. These bits should come with several adjustable cutters. Unfortunately, they are not particularly strong, can wander off course in moderately deep holes and the screw point has fine threads. This means that it clogs easily and may require frequent cleaning. Again, well worth buying at the right price.

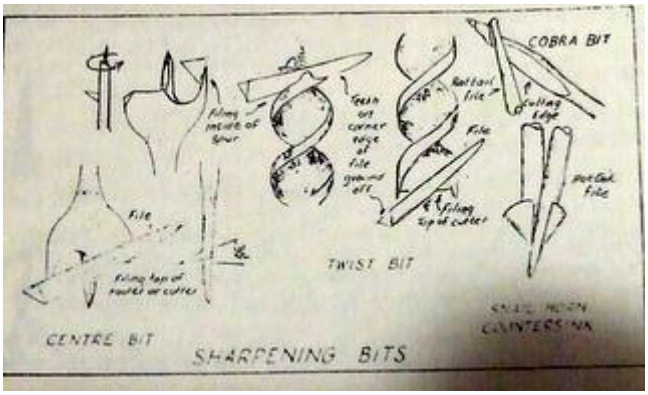


Cut "L" shows a gimlet. While it is not a true bit, it has a variety of uses, mainly for boreing small holes for nails and screws. Can cause splitting if used near the ends of timber.

The last cut, **"M"** shows a dowel sharpener bit. It is used for forming a taper on the ends of wood dowels prior to inserting them into dowel holes. Probably very useful if

you use dowels to any degree. I've included it more for recognition purposes than anything else. I've never seen one second hand, but you never know your luck.

The box below shows the sharpening sequence for putting an edge on bits. Wood bits are not particularly hard steel, and usually need frequent sharpening. This is done with a fine file although you could always finish the edge with an oil stone if you wished. Note that the spurs on the softwood augur and centre bit are sharpened on the inner side. To do otherwise will lead to a decrease in the diameter of the scribed hole; this in turn will lead to binding of the bit against the wall of the hole.

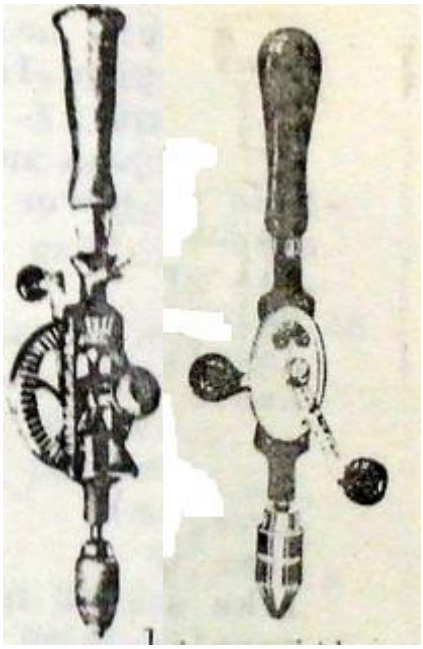


Also, clean the swarf from the hole as you go. Bits – especially the augur – should not

be turned in reverse. They will tend to unravel and break in the hole if you do. If they do jam, carefully reverse one to two turns and pull up while turning in a clockwise direction.

Drills

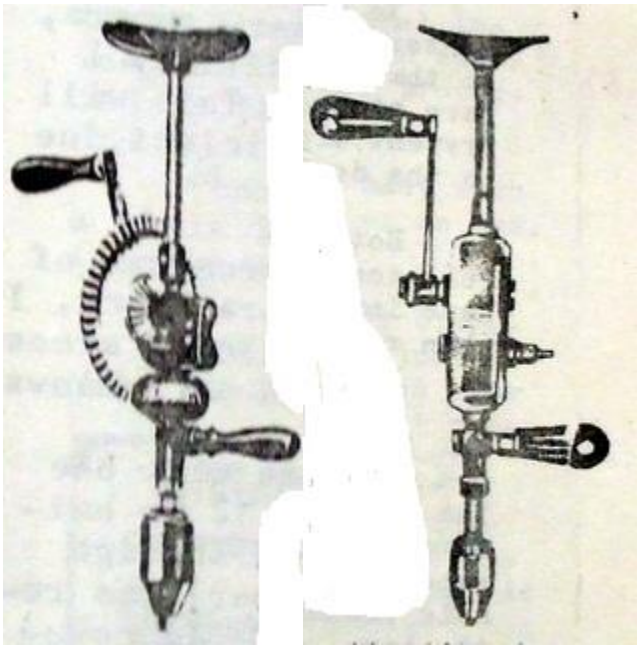
Hand drills may take many forms and shapes. While they may have more specific trade uses, basically they are no more than a method of holding and turning a twist drill.
If you have the opportunity I would suggest that you buy several sizes. The two cuts show drills that can be found in almost miniature form - What one might term a "jewellers' drill". I have one that cannot hold drills over 1/8". It is invaluable when drilling rally fine holes – say 1/32" or less.



My advice would be to look for the "jewellers' version" with a chuck capacity of 1/8", plus a GP (general purpose) version with a chuck ¼", plus one large drill that can chuck 3/8" – ½". It is with the large drill that you will have several choices.

To turn a large twist drill (especially in steel) takes considerable leverage. Thus the larger forms generally come with some form of variable gearing. In the cut on the left one can alter the driving gear to gain about a 1 – 4 step-down. While this is the sort of

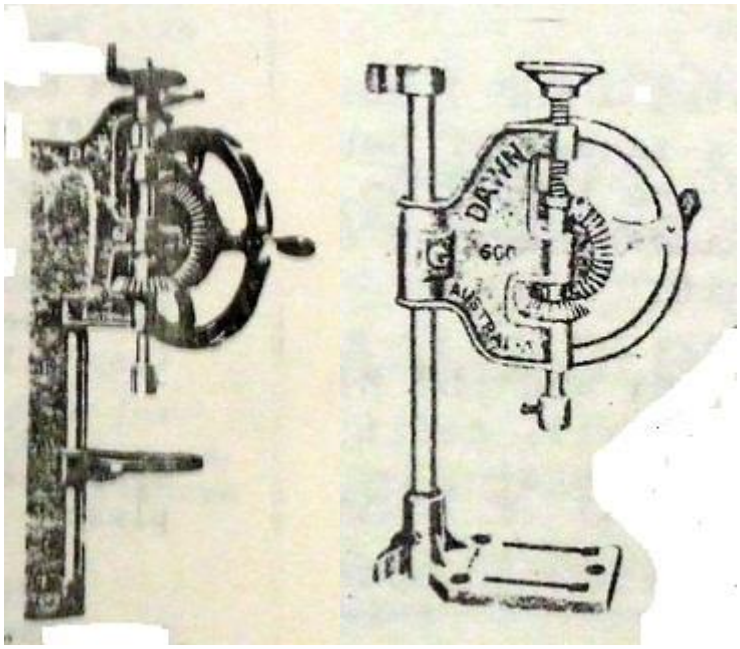
ratio that you want, I do not like the exposed gear system. From choice I prefer to go to a covered system as shown on the right. I have found that the closed units can shear the driving pin, which is a nuisance but not a disaster.



Incidentally, both of these drills are known as breast drills – “breast” being the upper chest – for leaning upon the plate at the top, not the centrefold variety, which would be somewhat out of place here – unless you are decidedly “kinky”!

If buying second hand drills, pay particular attention to the jaws in the chuck (there should be three, unworn and unchipped), and to the driving lever. Particularly on the exposed gear type, the lever can loosen or become very distorted. While such wear can be repaired, the price should reflect the condition, not your hopes.

My last two cuts illustrate a form of drill that is not common. They were known as “post” drills and were still being sold into the ‘60s, yet I have only seen two for sale and both were priced at more than new prices for bench drills.



As the name suggests, they should be bolted to a post – which may be a problem in a modern workshop. I think they would be a good buy, especially for those in the bush. Check the gears for wear though.

3.3 Wood Chisels

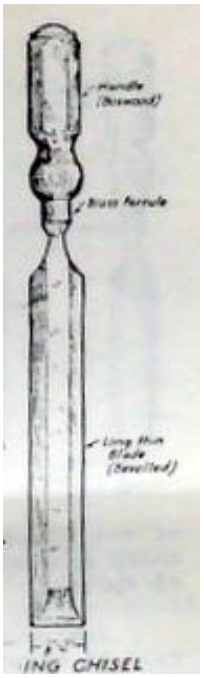
It is interesting to see that of all the old-fashioned hand tools, chisels have suffered most from modern fads. Consider for one moment that chisels, in one form or another, date back to the Stone Age. They have stood the tests of time through countless generations. The basic forms remained unchanged for hundreds of years, right up until the last 20 years that is. I do not know the reason for the change but would guess that it is a combination of the loss of hand skills, and the "better looks" of just one chisel – the Bevelled Edge Firmer Chisel.

Up until recently the most common and widely used chisel was the firmer chisel, it is a

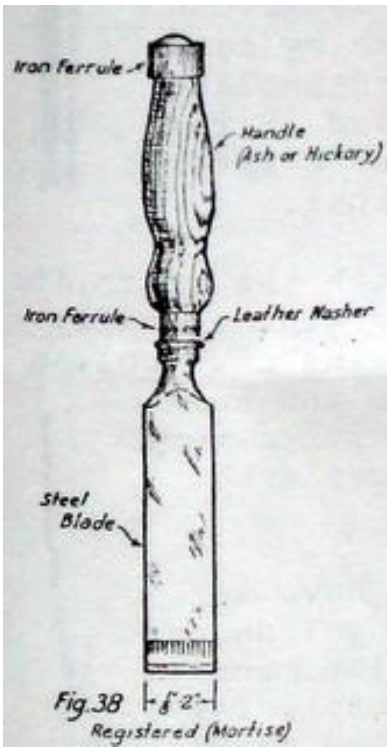
solid (sometimes almost “block”) chisel. It had no ornaments or fine lines, but it did cut wood! For almost all day-to-day requirements it performed in a fine fashion. While it was designed for most of the normal jobs it did not have a fine blade for paring, nor an extremely heavy blade for the very heavy jobs sometimes encountered.

It is a tool that can be passed on for generations and one that is sometimes found with a blade sharpened almost back to the handle. It comprises of three parts – A blade, a handle and a ferrule to stop the blade tang from causing the handle to split.

To a large degree, the firmer has been replaced by the bevelled edge firmer. Where the firmer could be struck with a mallet, the bevelled edge was designed for lighter use where a mallet would not normally be required. It came into its own in paring (cutting across the grain) and in cleaning up the corners of holes cut into timber (usually called mortises). Because the edges were ground back at an angle, it could reach right into a corner without disturbing the sides of the mortise. As I said before, the bevelled edge has taken over. I suspect that this is because it looks better, and a lot of tools are bought by women who want “hubby” to be a bit more useful around the place. Which is not to denigrate the chisel, most of mine are bevelled.

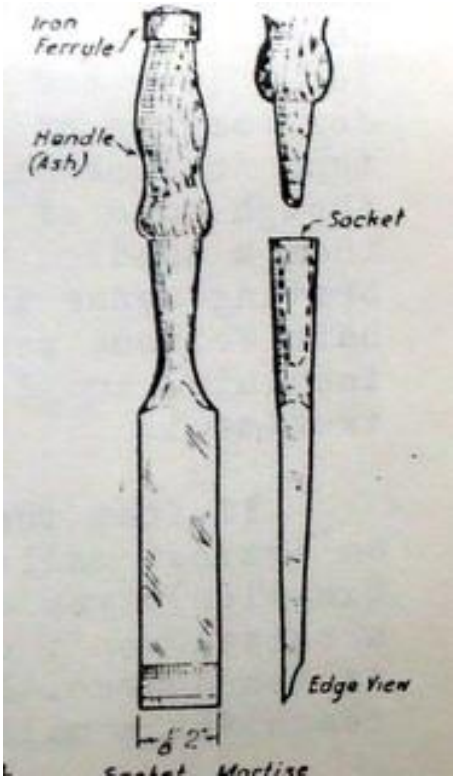


The paring chisel is what might be considered as the extreme version of the bevelled edge chisel. Usually only found in specialised tool shops or as a “deceased estate” , they are both specialised and very useful – but only for light paring work. The original intention was for a chisel that would cut a clean cut across wood up to about 250mm wide. They should never be used with a mallet, as one glance at the ornamental handle will show.



For medium heavy work, in conjunction with a mallet, one should use a registered mortise. It was designed for such use, with an iron or brass ferrule at both ends of the handle. As the name implies they were primarily used for mortises in hard timber, or where the mortise was of a reasonable depth. It must be kept firmly in mind that even with the registered; it was not designed for leverage.

Most chisels suffer abuse by users who insist on pulling the handle sideways, thus exerting considerable force on the blade, especially where it bears against the side of the mortise. The blade may show its displeasure at this treatment, and break.
If the chisel is properly sharpened and the operator knows a few basic points, such treatment is not necessary.

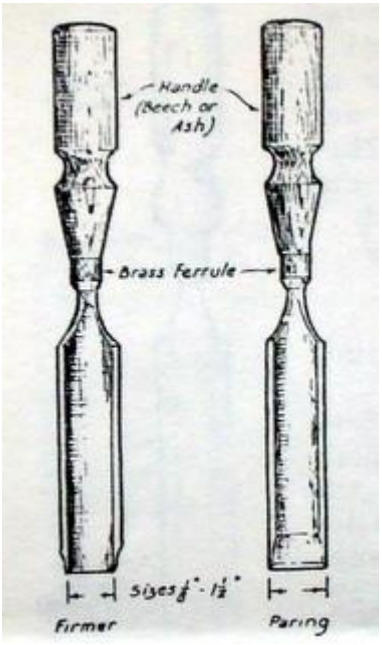


The only chisel I know of that was designed for extremely hard work, both with a mallet and as a lever, is the “socket mortise”. Unlike the other tools which rely upon a metal tang to secure the handle to the blade, the socket reverses the situation. In this case the blade is formed into a socket which the handle fits. This gives maximum strength. It

was a tool that was designed for very heavy work such as wagon building, bridge work etc. Even in this instance the tool had to be sharp to work at maximum effectiveness. Again, they are becoming a tool that is increasingly rare. If you ever have the opportunity to buy either the socket or the registered at a reasonable pice I would advise you to do so.

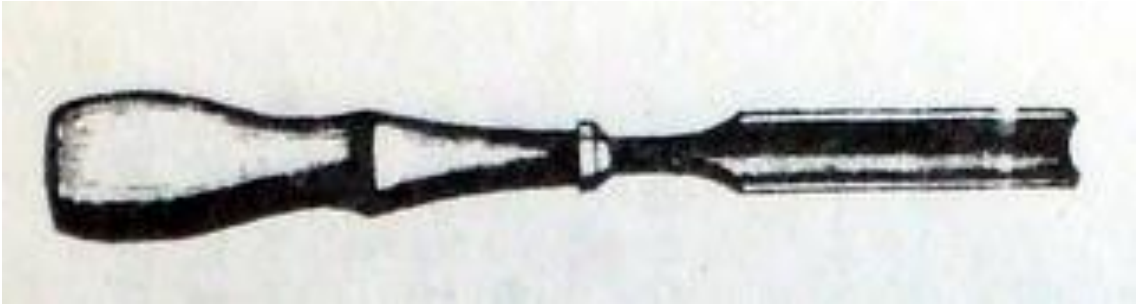
One point – if you found a socket minus the handle, don't pass it up. Most handles on old specimens wouldn't be much good anyway as they were a "consumable" item. They can be easily replaced and could be made from any reasonable piece of hardwood that was filed up to fit. The metal ferrule at the top could be made from a short piece of galvanised water pipe or any other metal tubing (other than copper) that you had lying around the place.

Gouges are no more than curved firmer chisels. They are becoming increasingly rare, though I have bought several in the local markets. They are extremely useful in a limited way, and well worth buying if and when.....



Gouges can be divided into two classes – the Firmer (which is ground on the outer edge) and the Scribing (which is ground on the inner edge). I have it in my mind that

they can also be called Incannelled (Scribing gouge) and Outcannelled (firmer gouge) though I can't even find a reference to check the spelling on that.



Firmer are used for gouging with the grain, the scriber for paring across the grain. Generally, they can be regarded as roughing out tools, as they are usually used to remove the bulk of the timber. Final smoothing up could be done with a very sharp specimen, though most craftsmen seem to use a set of specially shaped scrapers. Grinding the firmer is simple, though you have to roll it across the face of the grinding wheel to get an even facet. It is sharpened on an oil stone in a similar manner.

Sharpening the scriber required a curved face wheel, for the grinding and a slip (curved edge stone) for the sharpening. Needless to say, many were never sharpened properly. Wood turning chisels are similar in shape, but mostly have a much longer blade and handle. They are of little use for normal hand woodworking as the extra length makes them very difficult to control on all but very limited jobs. However, at the right price.....

Another form of curved chisels are carving tools. As a general rule these are both smaller and finer than the gouges and they cover a far wider range of shapes. They are extremely useful to have on hand for a wide range of paring and gouging jobs. I have had a set for years and while i have never used them for carving as such, still use them frequently. While one frequently sees of carvers beating sense into a carving chisel with a curved mallet, I'd have serious reservations about doing so to mine. The blades are far too thin and I doubt they would put up with that sort of treatment.

If from the foregoing you have gained the impression that i am against mallets (hammers and chisels are an unmentionable combination), you are dead right. It has been my experience that if the chisel won't cut it is either too blunt or the grinding angle is too coarse. Personally, I would try both alternatives before I'd reach for a mallet. Anyway, that's just a personal feeling.

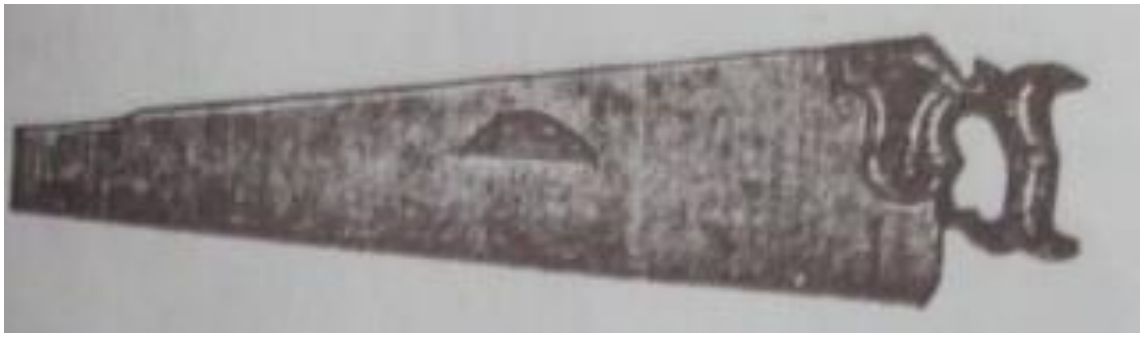
3.4 Saws

The second-hand shops, flea markets and school fetes are a rich source of second hand saws. If you know what you are looking for, and know how to judge what you see, you can buy rare bargains.

For our purposes we shall start by dividing saws into two groups – those that cut straight lines and those that cut curves.

The "straight" cutting saws can be divided into three groups:

The "rip" saw is one that cuts or rips along the grain; unusually it is of a reasonable size – about 60cm long. The teeth are similar in shape to the roof of an old factory, or a railway workshop. The teeth act as chisels and gouge the wood away, since they are cutting with the grain.



The "cross cut" is similar in size and shape but has sloping teeth. The teeth are sharpened on the sides to produce a razor edge. This enables the saw to slice through

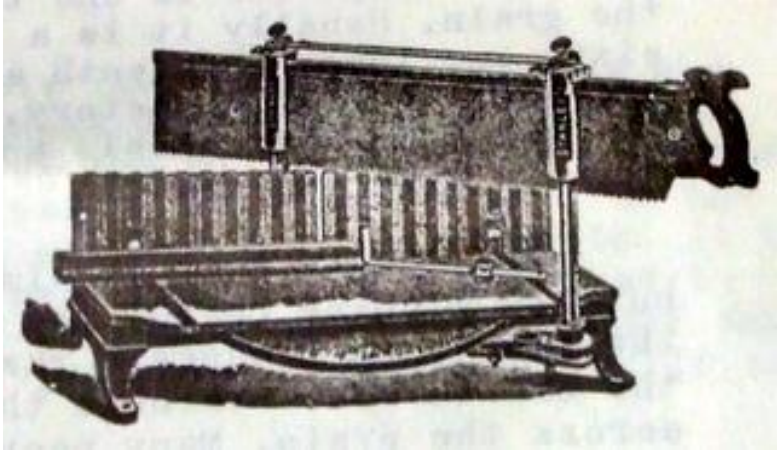
the wood fibres and cut across the grain. Many people cannot tell the difference between the two, yet it is quite apparent when you know what to look for. Either saw will do the job of the other, but not as well.

Cross cut saws come in a number of sizes ranging from 40cm to 66cm. They all have their uses although I wouldn't bother with any saw under full size. If you are going to use a saw properly, you need a decent length to get a full cut per stroke. In restricted areas I would select another saw.

There are "old" saws and there are old saws. The simple rule is that anything of quality will be taper ground. In other words, the top edge or "back" will be slightly thinner than the metal just above the teeth. The grinding away of a bit of metal means that the saw is less likely to jam with saw dust. In other words, it makes the operators' job easier, which is a sure sign of quality. That is not to say that any saw that is taper ground is a good saw. If it has been in a fire or badly bent, it won't be as good as a cheap make.

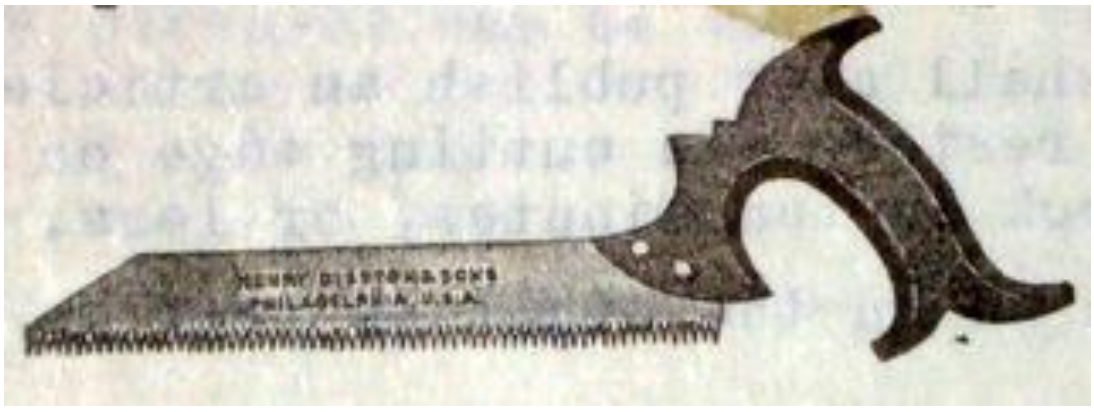
One group of saws come with stiff metal backing rib. While usually known as "tenon" saws they may be one of a number of special purpose saws including mitre box saws.

Mire box saws are about 60cm long and are designed to fit in a mitre box. Which raises the point that if you ever see a mitre box at a reasonable price – say from $1 to $20 (1980s pricing) it could be a very sound investment. Mitre boxes will enable you to cut angles to a precision that is hard to match with free hand cutting.



The tenon saw (named for cutting tenons as in mortise and tenon joints) is the most common saw in this group. They range in size from 20cm to 40cm. They are a very useful saw, and frequently disposed of, when grandpa goes to that big joinery shop in the sky.

Dovetail saws are just a smaller version of a tenon saw. They come in two versions, either with an open handle or with a peg type handle; the sizes are about the same. I am of the opinion that the handle shape was a matter of personal preference, rather than a difference between saws.



All of the backed saws may on occasion be found with a brass stiffening rib. As far as I can tell, brass was not a sign of quality. In the “good old days” brass was much cheaper than steel, and so was probably used as a cost cutting factor.

Saws are measured by the number of points per inch. A fine tenon saw could have had as many as twelve teeth per inch and the big rip saws as few as four. So it is the number of points as well as length that determines the timber removing ability.

From time to time, one will see various types of crosscut saws in the marketplace. Of all that I have seen so far, I’ve only ever seen one worth buying and I did! They mostly seem to have been stored out in a shed, or in the weather. There are usually covered with rust pits, which makes them almost useless.

Crosscuts are of two types, the one man, which is simply an oversized crosscut saw, with a hole for a peg at the toe of the saw. As the name implies it is for use by one man, although two can use it if required.

The two man cross cut is a far thinner bladed saw with a peg on each end, it can only be pulled in the cut, hence the two pegs.

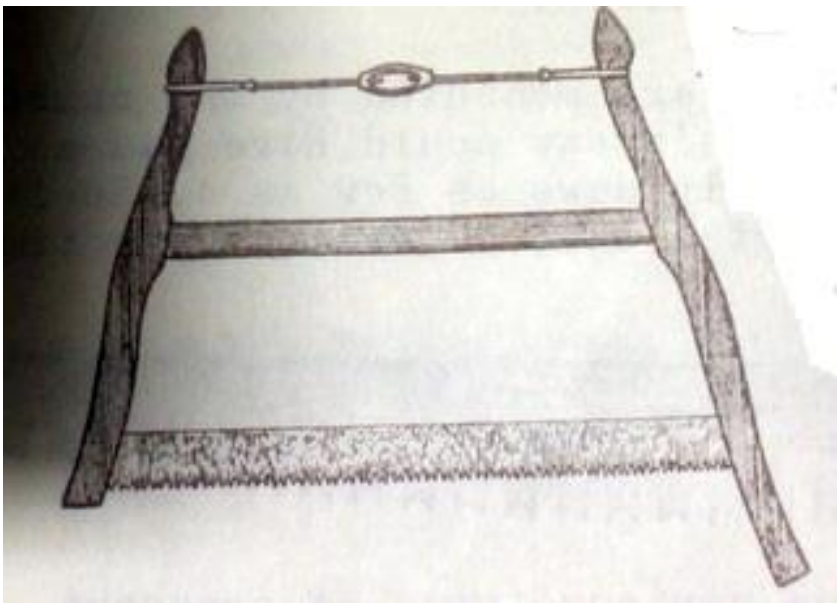
There is a deal of skill required in using a two man saw, and many feuds can stem from someone who is not pulling his/her weight. They also require skill in keeping them to a straight cut. Unless you have big timber lying about you are better off with a one-man. (you can’t – usually – argue with yourself).

You will find that lengths will range from 1 to 2 metres and points from 2 to 4. Teeth will vary in shape quite considerably.

Any good crosscut will have a ground blade, it may be half the blade thickness at the back and since these saws can jam very easily, this is an important point.

Anyone using one of these saws is well advised to have a tin of floor wax or car polish on hand. A liberal dose of wax every 10 minutes or so will make the job a great deal easier, and enable the saw to cut faster.

Curve cutting saws are a varied lot. Of the framed saws the largest is the buck saw, they are normally used for cutting up firewood. The blades are up to 76cm long and as much as 6 cm deep. The teeth were often patented types, which could make them somewhat difficult to sharpen, besides which some were hardened to a degree that made them difficult to file. Being a wooden frame they had a habit of breaking, being wood they are fairly easy to repair.



Another frame saw is the bow saw. Similar in appearance it is used for cutting curves (the buck is not usually regarded as a curve cutting saw). The blade in the bow saw can be turned in the frame, after tension has been released by turning the turnbuckle at the top. Both of these saws should only be used by gripping one end, the fact that the bow saw has knobs at both ends is for turning the blade, not holding. Bow saws are about 40cm long, the blade about 7mm wide. Replacement blades could be hard to find, it could be necessary to cut a length of band saw blade to fit.

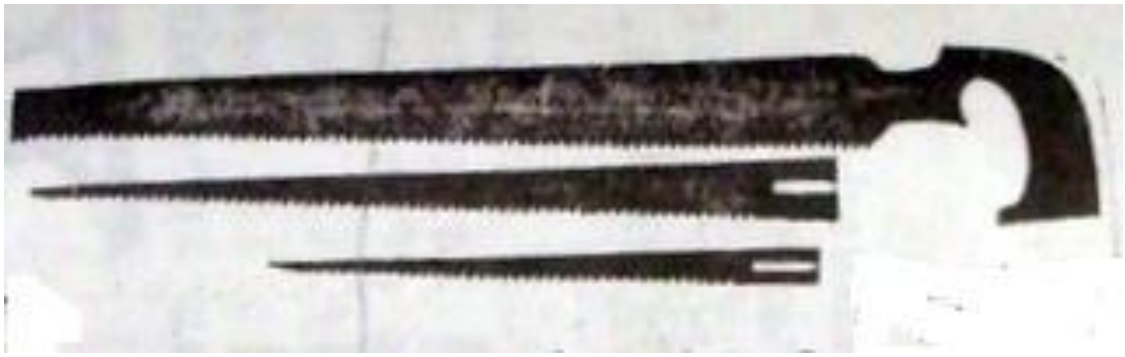
For cutting thin timber, say up to 25mm or so, the coping saw is ideal. There are a lot of varieties about and unless you can get a Turner or a Stanley, or other good make, be prepared for some problems.

Blades are fitted by holding the pin inside the frame and unscrewing the handle five or six turns. The two pins are moved to the desired angle and the handle screwed up. Make sure the two pins are at the same angle.

When the handle is screwed up tight there should be no movement between the handle and the frame. The rear pin and spindle should be reasonably tight in the frame. Also the metal ferrule over the handle should be of good length to prevent the handle from pulling off. Should the handle pull away, lightly grease the threaded spindle and pack plastic putty into the handle. Take the blade from the frame and then screw the handle back on. The plastic putty will set and hold the handle in place. The handle will unscrew again because the grease will stop the plastic putty from sticking to the threads.

Coping saws are sometimes mistakenly called fret saws. Fret saws are much deeper in the frame and use a finer blade. As the name suggests they are used for “fret work” which is an ornamental cutting of thin wood as found on old fashioned radios, sewing boxes etc. It is a hobby that had died out but the saw is a useful tool to have if you can locate suitable blades. (some larger hardware stores stock piercing saw blades which will cut both wood and soft metal, and fit a fret saw.)

Both fret and coping saws can be started in from an edge by drilling a small hole through which the blade is passed. The saw is then fitted to the blade and the cutting commences. Fret saw kits came complete with an awl for just this purpose. (on some jobs it may be necessary to use a coping saw to cut a slot so that you can start the toe of a crosscut or rip saw.)



A group of saws that have fallen out of favour are the keyhole and compass saws. When sold with three blades they are known as a nest of saws.

Keyhole saws have a number of uses. With the fine pointed blade it is possible to start a cut working from a small hole. In soft timber it is sometimes possible to start without a hole. By pushing the point into the timber and pulling back so that the teeth cut on the back stroke, you can work the saw through the wood. (I have started tenon saws in this way when sawing ply). The one point to watch is that you don't bend the narrow blade.

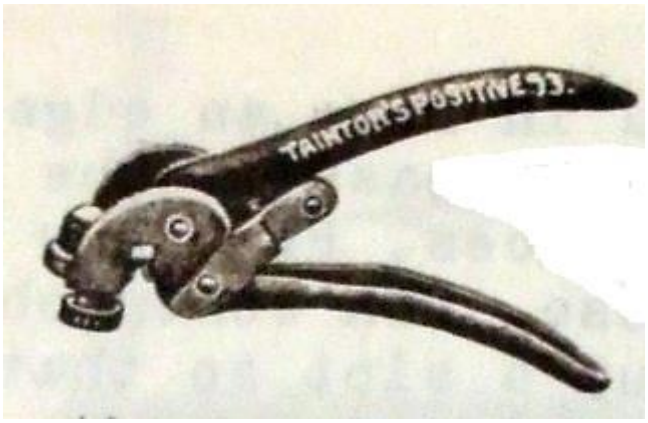
For some reason these saws usually come with blades that are less springy than other saws. If the blade is set to a coarse set, it is easy to cut a fairly tight curve with them. This is particularly true when the inner side of the curve is not required. In that case you can use the edge of the blade as a rasp, and by constantly backing off and cutting with just one side of the saw, can cut very tight curves.

Keyhole and coping saws are frequently confused with pruning saws sold by nurseries. This is understandable since early models came with a pruning blade. Pruning blades are wider, less tapered and have teeth that cut as the blade is pulled towards the operator. They can be used for normal cutting purposes if and when required.

A similar and very useful saw is the pad saw. Usually they come with a very short blade – say 15 cm or so. On occasion they will be found with metal cutting blades. As an alternative, you can often fit a broken hacksaw blade to one. This will enable you to cut either wood or metal as the case may be.

I have seen them with wooden and metal handles and a recent trend has been to market a metal pistol grip version. This would probably be the most useful shape of all. When using a pad saw i like to fit the blade so that it cuts on the pulling stroke, it is far easier on the blade.

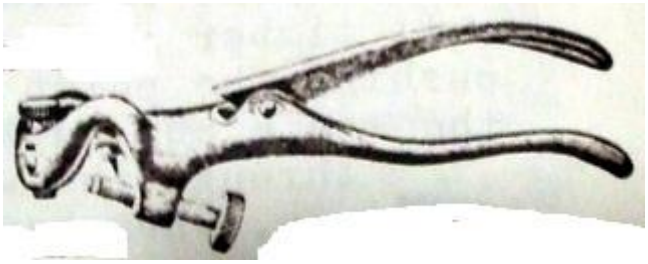
For special jobs you can make up a temporary pad saw by taking a short piece of dowel, slitting the end and fitting a jig saw (sabre saw) blade secured with a screw. With this arrangement you can start a hole of sufficient length to start a rip or crosscut. Makes people wonder sometimes how you started a cut without any lead in. (That is what is known as a “trick of the trade”)



The pliers looking device shown here is a saw set, they are used to bend or “set” the saw teeth to the required angle.

Unlike pliers, the jaws are fixed. Squeezing the handles causes a tongue to project and push against the anvil. If you do buy a second hand set, check and see that the tongue has not worn away, or become misshapen. Also make sure that it comes hard up against a (usually) circular block. This should have one edge ground off to an increasing degree as it goes around the circumference. Often there are numbers stamped around the side - 16, 12, 8, 6 etc.

Saw sets can be bought new for only a few dollars but you will sometimes see them in the marketplace. Few people know what they are and fewer people know how to sharpen a saw.



Screws - as in holding the handle – can be purchased in a few of the larger hardware stores. There is not much point in buying them unless you need them, but it is useful to know that you can still buy them if required.

It is also possible to buy saw handles in the large stores. The ones I have seen had second rate timbers in them but could save you the work of having to make a handle. Personally, I'd prefer to make a handle if I had the right timber. It is necessary to use a fine, close-grained wood – beech, apple or something similar, though even pine would do in a pinch.

Saw vices are cast iron devices that clamp to a bench and hold the saw blade for setting and filing. They are even less recognised than saw sets and you just might happen across one sometime. I am still looking but you never know your luck. (*Note: The instructions for making a homemade saw vice may be found later in this eBook*)

The points to look for with a saw vice would be the condition of the jaws, how it mounts, and whether it is adjustable. Over the years it is likely that the tops of the jaws would be file marked. This would not matter if the cuts were not too deep.

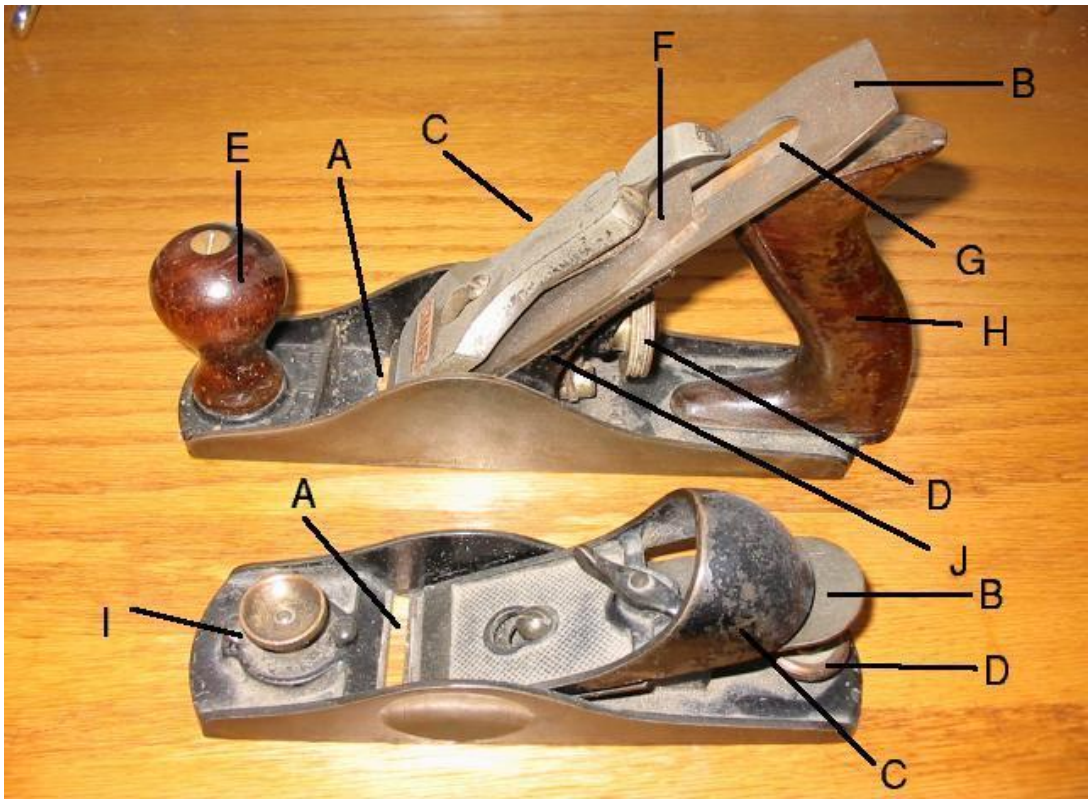
You should check that the jaws close evenly along their full length , sometimes they get "sprung" and will not grasp the blade properly, the blade can then drop at one end when the file pressure is applied.

If the vice is adjustable for different blade thicknesses it might be possible to file away the inner faces to a degree where you would again have the jaws parallel. You would want to look at this point before you parted with hard cash. While it is usually possible to fix tools, sometimes it is just not worth the time and amount of effort required.

3.5 Planes – General Purpose

Please note that the photos for this article were taken of my plane collection which is not as high a quality or as extensive as Bill's (except the first one which I got from Uncle Wikipedia).

The Parts of a Plane



Two styles of plane are shown with some parts labelled. The top of the image is a bench plane; the bottom is a block plane.

A: The mouth is an opening in the bottom of the plane down through which the blade extends, and up through which wood shavings pass.

B: The iron is a plate of steel with a sharpened edge which cuts the wood. Some people

refer to it as the blade.

C: The lever cap holds the blade down firmly to the body of the plane.

D: The depth adjustment knob controls how far the blade extends through the mouth.

E: The knob is a handle on the front of the plane.

F: The chipbreaker or Cap iron serves to make the blade more rigid and to curl and break apart wood shavings as they pass through the mouth.

G: The lateral adjustment lever is used to adjust the iron by skewing it so that the depth of cut is uniform across the mouth.

H: The handle on the rear of the plane.

I: The finger rest knob Block planes are held in the palm of the hand while the tip of the user's index finger rests in the indentation on top of the knob. On some planes the knob is used to adjust the size of the mouth by allowing a sliding portion of the sole to be moved back or forward to accomplish this.

J: The frog is a sliding iron wedge that holds the plane iron at the proper angle. It slides to adjust the gap between the cutting edge and the front of the mouth. The frog is screwed down to the inside of the sole through two parallel slots and on many planes is only adjustable with a screwdriver when the plane iron is removed.

Metal Planes

It has long been my opinion that you can never have too many hand tools. While one can perform a multitude of tasks with a limited number of tools, I prefer to have specific tools for particular tasks. I buy planes when the opportunity presents itself and I suggest you do the same. Never be afraid of buying second hand tools, if the article looks clean, does not have any damage or missing parts, and the price is right then you have little to risk.

Local trash ‘n treasure markets, auctions, deceased estates, school fetes – all are opportunities to buy planes and other tools. If you have the chance to buy a metal body plane that is missing parts it pays to remember that plane irons (blades) and handles are regarded as consumable items and can be found in hardware stores. I do not know whether you could buy a replacement back iron or a new frog so look at the tool with that in mind.

If you buy second hand tools, take the time to clean them up before you start using them. With my planes I like completely dismantle them and thoroughly clean all parts. Put a light smear of grease on all threads before reassembly, grease under the frog to prevent rust forming.

When adjusting the frog, (and I am presupposing here that you have just cleaned the tool up and that every part is rust free) you will find that there are two securing screws that pass through the frog into the body of the plane. At the back of the frog, beneath the blade adjustment screw is the frog adjustment screw. Just nip up the two securing screws lightly, fit the blade and cap iron, and move the adjustment screw until you have a gap of about 2mm maximum between the front of the blade and the mouth. Remove the cap iron and blade and tighten the securing screws.

The screw through the lever cap should be just tight enough that there is firm pressure when the lever cap is depressed. Note that the lateral adjustment lever usually lies to one side when the blade is properly centralised (some seem to think that the lever must be central on the plane).

Metal planes were sometimes referred to by number, number 4 is a smoothing plane; number 5 is a jack plane, a foreplane is number 6 and a trying plane is no7.

Wooden Planes

Many look upon the old wooden planes as something that is best suited as an ornament, given my preference I would far prefer to use a wooden plane than a metal one. Unless there is something wrong with the sole, a wooden plane is always easier to push, and I think that it does a better job.

Unfortunately, all planes need frequent sharpening and therein lies the reason for the metal planes popularity, they are easier and quicker to disassemble and reassemble as well as being easier for the novice to adjust, since the blade depth is controlled with a screw rather than by tapping with a hammer. There were quite a number of wooden soled planes available in the past, at that time the tradesmen sought out the best of both types and got it. If you ever get the opportunity I would suggest you buy any examples of these hybrids (wood sole and metal upper) as they are a delight to use.

If you get the chance, don't pass up full wooden planes either, once you know the ways of them, they will soon become your favourite. However, before you start throwing good money around, make some basic checks. Make sure there are no cracks or splits in the body of the plane; wooden planes were usually made from English beech, it is a hard and stable timber, not given to splitting when correctly seasoned. Make sure there are no parts missing, if the plane is in epics there should be a body, a blade, a cap iron and a wooden wedge. You can expect that the wedge will be gapped and chipped at the top and it is likely that the top of the blade will be showing the effects of hammer blows, neither is usually any great problem.

To take the blade out, hold the plane body in one hand and strike the rear end of the plane with a wooden mallet. Doubtless there will be many marks at the end where various clowns have used hammers, either not knowing or not caring to use the correct tool. Some of the jack planes (and larger) came with a wooden button at the front of the plane. This was not a handle that had broken off, but a striking pad for knocking the blade out. While you can hit the button (that is the toe of the plane) I prefer to strike the heel.

With the plane disassembled, start a cleanup of the parts. Frequently you will need to scrape away encrusted dirt from the sides and top of the plane. Once that is done I like to use a piece of coarse steel wool and a few drops of raw linseed oil. The steel wool cuts away the grime and a measure of surface wood and the linseed oil will penetrate the wood and form a protective skin or varnish. Once you have cleaned up all the wooden parts, including the handle and wedge, and cleaned down in the throat wipe off all the excess oil and steel. Allow the oil to penetrate for a few days and oil again, using very sparing coats.

Clean up the plane iron and the back iron using emery cloth and kerosene if necessary. Grind off any distorted metal at the top of the back iron. Sharpen the blade and wait until the oil is dry on the wooden parts. To assemble the plane, fit the blade so that it ALMOST penetrates the sole and slip in the wedge, then push the wedge in hard with your hand. With very light taps of the hammer, drive the wedge down until it is deep enough, then knock the wedge with a mallet. If you have gone too far and the blade is too far out, a li9ght tap on the heel will loosen the wedge and you can start again. Lateral adjustment is made by knocking the blade sideways with a hammer. You will find that it really is quite easy and precise.

Before we look at the next category, there is one final point that I would like to cover. On average you will find that the width of a board planed is less than the width of the sole of the plane. From observation I would guess that the average board is about 40 odd mm wide. That is the width of the worn area on the sole of the average wooden plane.

It was always understood that a tradesmen would resurface the sole of a plane as and when necessary. This was done by sharpening and honing the blade of a long plane (maybe a Try plane or Jointing plane) to a razor edge, setting it very fine, and carefully removing fine shavings until the worn area was cut away. The new surface was then either waxed or oiled with linseed oil. If you want to obtain a true surface, i.e. one that is flat and straight, use the longest plane you have. A long plane will only cut off the high spots – same principle as a road grader – they don't make them that long for fun!

Block Planes

In keeping with wooden planes, the block planes are adjusted with a hammer; normally there is a small button on the heel for striking with a mallet. Lateral adjustment is with a hammer but as I said before, it is very accurate once you are used to the method.

Unlike most planes the block plane has no cap iron and interestingly the blade goes in "upside down". Normally the blade is fitted with the grinding facet to the sole of the plane but in the case of a block plane the grinding facet faces up. A cap iron is usually

fitted to “break” the shaving and stop the wood from tearing or splitting away in front of the blade. The block plane got around these problems by lowering the angle of the blade and making a handle from what would normally be the lever cap iron. Anyway, even if you don’t understand the principles, they are a good plane to have. (They are also good for starting your offspring off on the timber butchery trail – they fit the small hand better than most other planes).

3.6 Planes – Special Purpose

Bull-Nosed Planes

Quite a number of planes were designed so that the blade was situated toward the front of the sole, in other words you could plane into a corner. If the blade was covered by part of the plane body, the plane is “bull-nosed”, if the blade projects out to the sides of the body it is a rebate plane. The photo is one type of bull-nosed rebate plane, in a block plane size and style. The sizes ranged from the little one shown, up to ones almost the size of a jack plane (no.5). There was a variation where the bull-nose was

disregarded and the blade was fixed straight to the toe and in theory it would plane right into the very corner.

Router Plane

Before the advent of the power router, tradesmen depended on the router plane (or Granny's Tooth), it is a very simple plane that was capable of very accurate work. It was designed to level the bottom of trenches, mortises, sockets, grooves etc. It had a blade that was bent at right angles, was very thick in section, and extremely rigid. This would plane the top off any projections after the critical work had been done. Blades came in a number of widths – ¼", 3/8" and ½" being the most common. While most blades were normal, i.e. at right angles to the side, some were ground at 45° to each side, similar to a plough share. Blades are still available and you can occasionally pick up entire planes.

You can extend the capability of a router plane by screwing the body to a wide board, then it is capable of bridging any gap and most are pre-drilled just for this purpose.

The Compass (or Circular) Plane

The compass plane is a very useful, though somewhat limited addition to the toolbox. When properly sharpened and adjusted the compass plane will make precise curves (either convex or concave) in wood. Moreover it will stop once you have achieved the desired curve. Unfortunately this comes at a price – due to the nature of wood, on any curve you will be planning against the grain at some point. In other words, you will have to plane from both ends if you wish to achieve a smooth and accurate finish. This is not a fault of the plane so much as it is the nature of wood. The problem can be overcome – to a degree – by sharpening the blade to a razor edge. The big advantage of the compass plane over the spokeshave (see later) is that it is far more easily controllable. It is not so likely to chatter (bounce up and down and leave ridges) and it will give a more even curve, if that is what you want. I doubt that I would use my compass plane more than once a year, but I still regard it as irreplaceable.

The Spokeshave

The spokeshave is, as the name suggests, a plane for shaving spokes! In “the good old days” they were used by wheelwrights and such for rounding timber. Spokeshaves come in two types and two versions.

Firstly, there is the wooden Spokeshave, they comprise a body made from a single piece of wood , a a blade that is usually referred to as the “iron”, (as are most plane blades for that matter). In the days of yore, a wooden Spokeshave was adjusted with a hammer, the tangs being tapped to force the blade through the stock to the desired setting. They were a good tool but suffered limitations, the tanks would wear away the wood surrounding them and they were forever loosening up.

The wooden stock was followed by the metal stock. To my mind this was a great advance, as it used a different type of blade, a different style of blade locking and a different method of blade adjustment. I own two metal spokeshaves but wouldn’t with a wooden one unless it was for collection purposes.

The metal Spokeshave has a blade and a variation on the level cap iron, it also has two thumbscrews for adjusting it (if it is one of the more expensive versions). Many cheap models were made without the thumbscrew adjustments; they were adjusted with a hammer and did a fine job.

The two versions of spokeshaves are round and flat. The “flat” is designed for planing in either a straight line or on a convex surface but it could also be used on larger concave depressions.

The “round” Spokeshave will cut straight or flat surfaces but is designed to cut concave curves in timber. The “flat” has a flat sole and the “round” has a round sole. You can easily modify a “flat” into a “round” with the aid of a file. The round version is not quite as easy to use, as it requires more hand control to prevent the body from tipping forward. As with the compass plane you have to plane with the grain – which means planing from both ends.

Rebate Planes

Rebate (or Rabbet) planes are planes designed to cut a recess in wood. If the recess is along the grain and on an edge, it is a rebate, if it is across the grain and on an edge it is a trench, if it is away from the edge it is a groove.

As a rule, rebate planes will plane both rebates and trenches, the planing of a trench (going across the grain) requires that the plane should possess a spur, or small blade, just in front of the plane iron. The spur cuts the wood fibres and prevents the iron from tearing at the edge of the cut. It has been my experience that many spur cutters are missing from the rebate planes, however they are cheap to buy and you can always modify a spur to do the job. Personally, I like to use the spur whether I am cutting rebates or trenches. Also, don't forget to sharpen the spur (on the inner side only) if you want a clean-cut edge.

Fillister Planes

Once upon a time (up to the last war) you could buy sets of wooden moulding planes, these were a wooden plane on which the sole had been specially shaped. The blade was cut to a similar shape and the plane produced a moulding – such as would be found on the older door frames etc.

The only real problem with the wooden moulding planes was that you needed a toolbox full if you wished to cut many different sizes or shapes. This problem was overcome by the fillister plane, with my plane I have about 60 different blades and in old catalogues I have seen ads for over a hundred different blades.

The fillister must be one of the most useful special purpose blades that you can buy and I would strongly suggest you buy one if you ever get the opportunity. If there are no blades with it, and they do get lost, remember that you still may be able to buy spare blades from larger or woodworking specialist tool shops. If necessary you could always buy rebating blades and grind the required profile yourself.

The fillister is one of the very few ways of making up ornamental moulding for picture frames etc. You can no longer buy any decent selection of framing and if you can't do it yourself you go without. If you should have the opportunity of buying up old wooden moulding planes at a reasonable price you should do so. From time to time I have bought then for a dollar or two, sometimes split, frequently with pieces missing and depending upon the tool I frequently buy them just for the wood content.

Usually they are English beech although I have a couple that are oak, they can be cut up

to make new wedges for better planes with missing parts. The timber will be similar, and if you have a genuine antique plane it is acceptable to make replacement parts form a similar timber of the same age. You can also turn the timber in a lathe to make up small tool handles etc. so for the same reasons, should you get the chance, wooden jack planes and trying planes have a lot of timber in the body.

A bit about Sharpening Stones

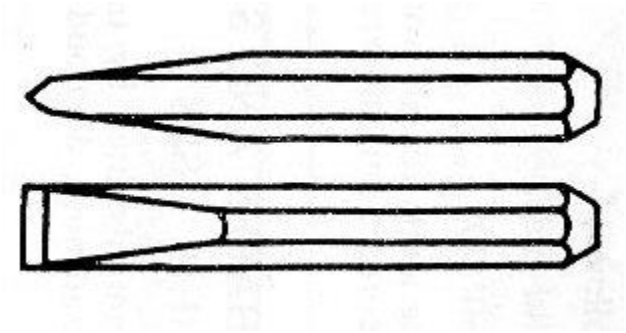
When you start using special purpose planes you will find a real need for proper sharpening facilities but suffice to say at this point that if you get the chance to buy up old oil stones, then do so because from my (rather biased) point of view, modern oil stones are rubbish. You just can't seem to buy decent fine stone, they are all far too coarse, the older stones are usually far smoother and for mine, give a much better cut. Buy up slips too, if you can. Slips are thin stones with rounded edges - you need them to sharpen curves.

3.7 Cold Chisels

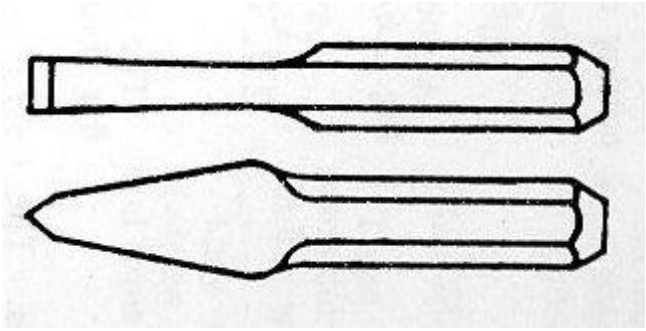
Cold chisels are used for working metals and sheet metal. There are six different types which used to be in current use but some have become rarer over the years.

Types of Cold Chisel

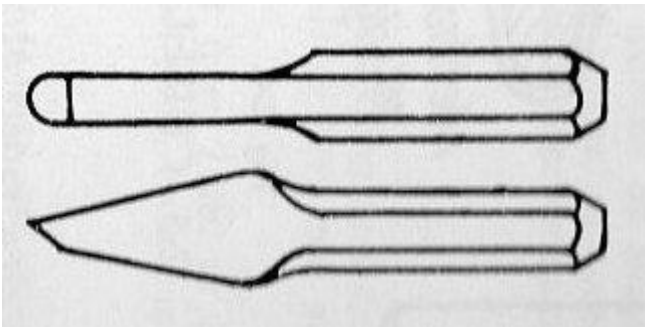
Flat Chisel – This is by far the most common type of cold chisel you are likely to meet up with at a "Trash and Treasure" market, second hand shop or your local hardware. It is also the most versatile, being used for general metal working duties. It is capable of being used to cut off rivet heads or rusted nuts and bolts, cutting rods or bars to length, cutting sheet metal such as a 200 litre drum or chipping back thicker metals. The edge is usually ground straight but may be given a convex cutting edge if particularly hard or soft metals are being cut.



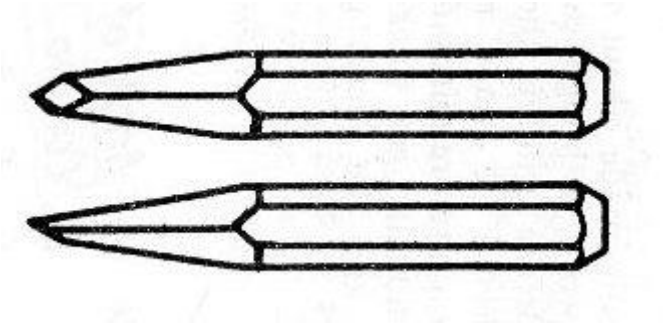
Crosscut or Cape Chisel – This chisel tapers back from the cutting edge to prevent binding in a groove and is used to cut keyways in shafts or pulleys or for cutting grooves in wider surfaces.



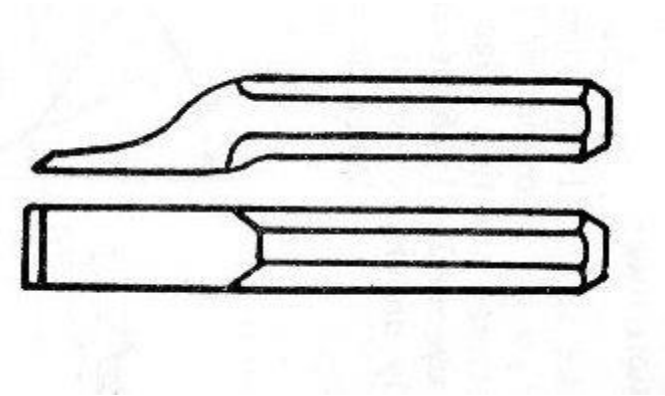
Round Nose Chisel – This is used to cut oil grooves in bearings etc but can also be used cut a small groove to bring a drill bit back into the centre of a hole where it has drifted off while starting a hole on thick metal.



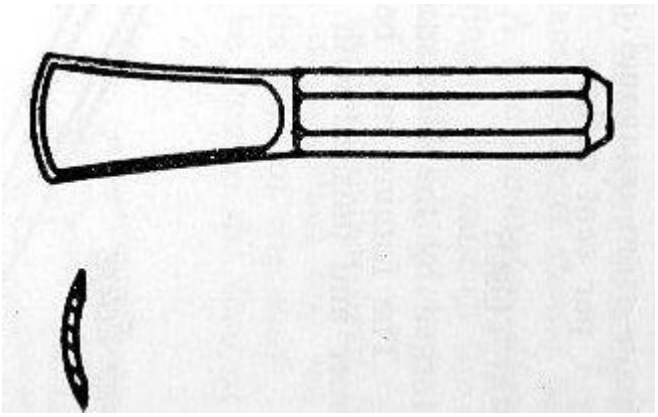
Diamond Point Chisel – The diamond point chisel is used for cutting vee shaped grooves in metal such as in large diameter metal pipe or metal plate to enable material to be broken off them. It is also used to prepare metal parts for welding and chipping out welds as well as squaring corners.



Side Cutting Chisel – The side cutting chisel is used for getting into those pesky corners to chip out metal or to access places which would inaccessible to a straight chisel. They are also used to true up keyways cut by the crosscut chisel.



"C" Chisel or Gouge – This is used where a half round surface is being cut or to enlarge circular holes.



Second Hand Cold Chisels

The following comments mainly apply to the more common “flat” cold chisel but could be adapted to the other types if you find one you are interested in. As previously mentioned, the flat cold chisel is the most versatile of the cold chisel family and is also the one most likely to be on offer, sometimes for as little as a dollar or two in places where second hand tools are found. Due to their versatility they can also see some pretty heavy service and by the time they get to you they may be in poor condition. That’s OK because with a little time, skill and access to a bench grinder you can get them looking new again (well almost!).

Mushrooming

While cold chisels are made from carbon steel, only the business end is hardened and tempered, the other end is left soft so that it can absorb the hammer blows without shattering. This is all well and good but if the people who owned the tools before you didn’t look after them it is highly likely that the metal on this end will be deformed by said hammer blows into a mushroom shaped end.

The mushrooming on the end of a cold chisel is undesirable for two reasons, the first is that the mushrooming has jagged edges which can slice open a finger if you are not carful. Secondly a lump of the mushroomed metal can come adrift while hammering and cause damage, particularly if it were to hit an eye or other sensitive bit.

To fix this problem, you need access to a bench grinder and it is easier if the grinder has a 25mm wide or wider wheel, the little 12mm wide ones are a pain to use. Hold the chisel horizontally and with the shaft at about 45^{o} to the face of the wheel and the mushroom head towards the wheel. Start up the wheel and rotate the mushroomed head against the face of the wheel, ensuring you move the mushroomed head across the face of the wheel so that you don't cause gouges in the face of the wheel.

Continue this process until all of the mushrooming has been removed and the top of the chisel is chamfered at a roughly 45^{o} angle. If you repeat this process regularly to remove the burr before it graduates into mushrooming it will be a quick as easy job and your cold chisels will always be safe to use.

Sharpening

Depending on the life story of your particular chisel, it may have been used for everything from chiselling out bricks to breaking up rocks so the cutting edge is likely to be pretty blunt. This is pretty easily corrected but also requires access to a bench grinder like the one mentioned above. As always, wear eye protection while grinding, preferably goggles or a face shield.

The cutting edge of the chisel has been hardened and tempered so it is very important during the sharpening process not to overheat it, ruining the temper and causing the overheated area to become soft. To prevent this take plenty of pauses and have a container of cool water next to the grinder to dip the blade into if it starts to get too hot.

Turn on the grinder and lean the chisel against the tool rest and place the cutting edge of the chisel so that the bottom facet of the cutting edge of the chisel lies flat against the face of the wheel. Move the chisel from side to side across the face of the grinder, turning the chisel over regularly so that metal is remove equally from both sides of the cutting edge. Don't forget to cool the chisel down so it doesn't overheat.

The included angle of the cold chisels cutting surface should be 60^{o} or thereabouts, so make sure it does not become too narrow or flat during the sharpening.

A regular sharpening will only take a minute or two and will keep your cold chisels in good working order for their lifetime. A wipe over with an oily rag once in a while will also discourage surface rust. Surface rust is a cosmetic issue only but if it bugs you, run the rusty areas against a wire wheel (which is also fitted to a bench grinder) to remove it, then give it a wipe over with the oily rag. It will be good as new!

4.0 Tool Sharpening

4.1 Sharpening and Grinding Equipment

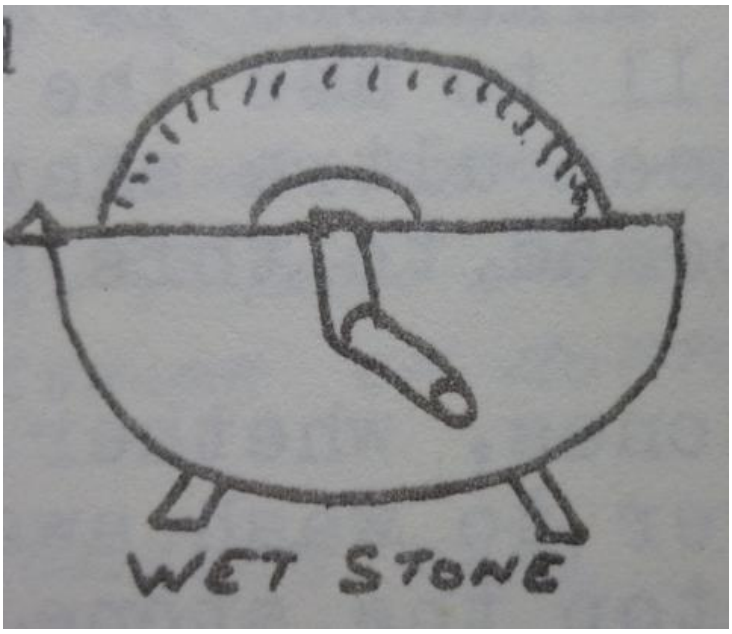
There comes a time in the life of all cutting tools, be they planes, chisels, axes or scythes, when the cutting edge has finally worn to such a degree that it is necessary to renew the edge to its original state of sharpness. Sharpening is a far simpler process than many realise, and one that is well within the basic abilities of most, if they understand the rules and principles involved.

Grinding is the fast removal of metal using a rotating abrasive wheel either motorised as per electric grinder or hand turned grinder. Occasionally one sees an old fashioned hand or treadle actuated sand or wet stone. (There are plenty of the former types, very few of the latter.)

The electric grinder (emery wheel) is a most useful tool. With a properly selected wheel of suitable grade, it will remove metal very quickly. Unfortunately this very speed

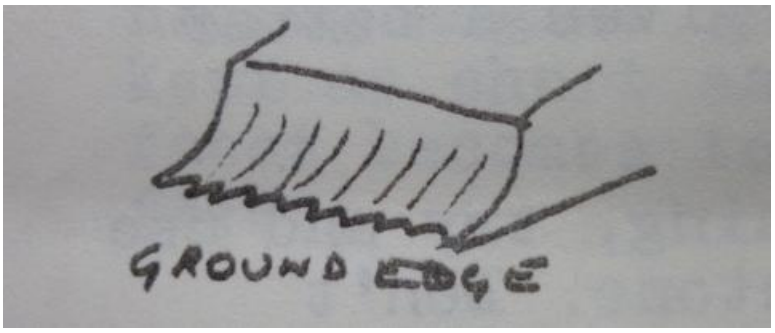
produces heat, and unless one is very careful the steel can be ruined if the heat reaches a high degree and the temper becomes drawn.

The wetstone is so named because the wheel is partially immersed in water. The water is carried around the wheel as it is slowly turned. The water serves to keep the steel cool and to wash away particles of steel that would otherwise clog the stone. The cutting action is much slower than an emery wheel, which is a major reason for wetstones losing popularity.



When ground by either of the above methods it is still necessary to hone the tool to remove the rough and serrated edge left by grinding and give a true and keen cutting edge.

NOTE: when grinding use the full face of the wheel to prevent uneven wear of the wheel. The sides of the wheel should not be used for grinding. Worn wheels can be trued and refaced to expose a new cutting surface with the aid of a wheel dresser or diamond 'stick'.



Honing is the removal of metal by rubbing the metal on a 'stone', the surface of which has been covered by a layer of fluid, be it oil or water based.

'Stones' come in various forms and grades and may be divided into two types. Those that are man-made and those that are of natural formation.

The artificial or 'man-made' are the type that you buy at any hardware store and are usually termed 'carborundum'; though they may also be a form of aluminium oxide. They are good stones and work well, though in my opinion most are far too coarse. Natural stones are mined. They are usually of a sandstone origin, but may also be marble, slate, or on occasion, shale. The best, and the best-known natural stones are Arkansas and Washita stones. All natural stones are costly when compared to artificial stones, and as a rule are too fine for average home use.

In my mind, a suitable grade artificial stone is one on which the edge of your thumbnail can be rubbed, without the sensation of abrasion, although the thumbnail will be

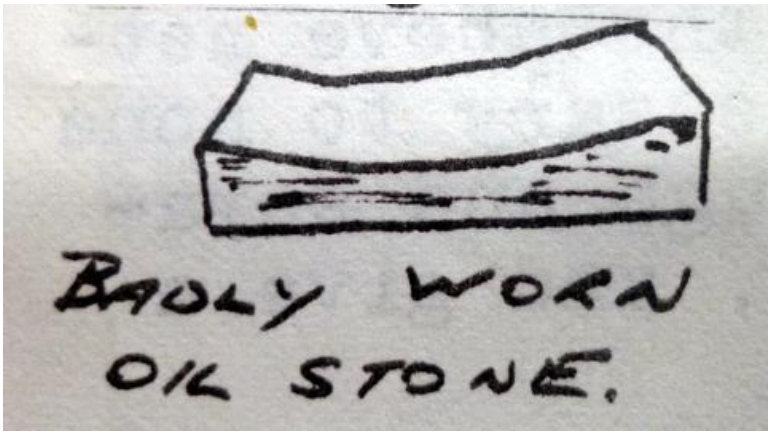
rapidly abraded away. Anything coarser is too coarse. Most cheap commercial stones are far too coarse, even on the ‘smooth’ side.

If you decide to buy a natural stone get either a ‘soft Arkansas’ which is medium grade or a Washita which is coarse grade (but still very much finer than most ‘fine’ artificial stones). To buy either ‘fine’ or ‘extra fine’ Arkansas stones is a waste of money unless you have the skill to use the stone, and have particular requirements than need ultra-sharpness. Only very fine steels can be sharpened to this degree.

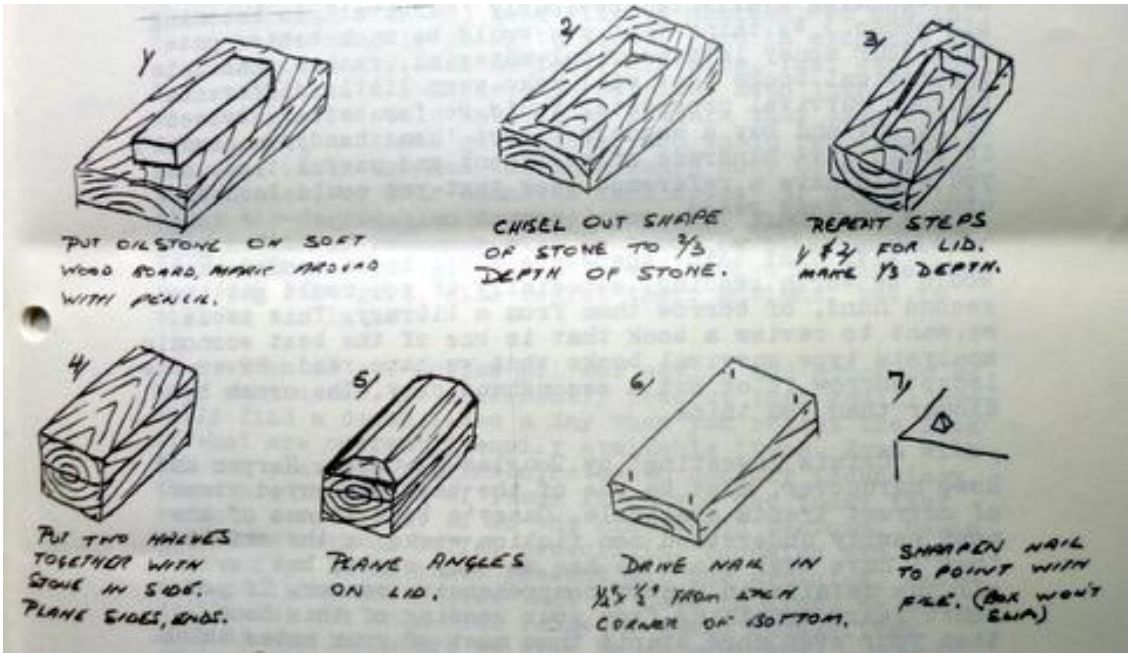
All stones, whether artificial or natural, need a liquid cover to wash away particles of stone and steel which will stop the stone clogging. A 50/50 mixture of car oil and kero will do well. Neatsfoot oil is a very good honing oil, but it is more costly and hardens in cold weather. I prefer it myself as it gives a better cutting and washing action.

When using a stones for honing, try and use the whole surface of the stone. Don’t abrade on the same spot or you will quickly wear a hollow at that point and thus ruin the stone.

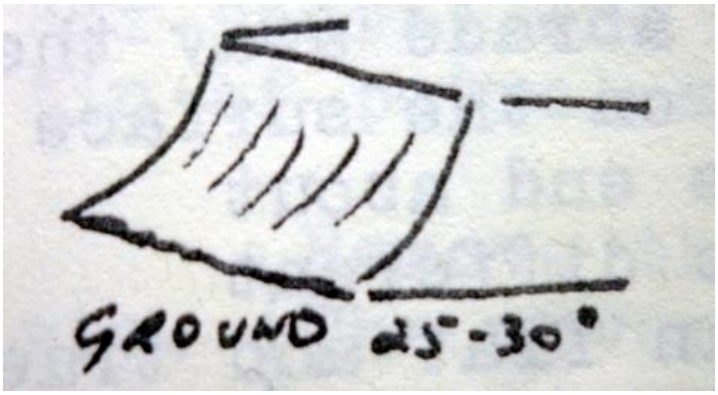
NOTE: I’ve purchased badly worn stones in second hand shops for nominal prices. They can be refaced using a bucket of sharp sand and a hard flat surface. Put some of the sand on a hard flat surface such as a piece of marble, a big quarry tile, or a piece of glass. Wet the sand with water and rub the stone back and forth to abrade away the high spots. Keep plenty of water and sand on the surface to speed the cutting. Also, turn the stone end about frequently, and keep shifting the stone to different parts of the surface so that it will remain flat and true.

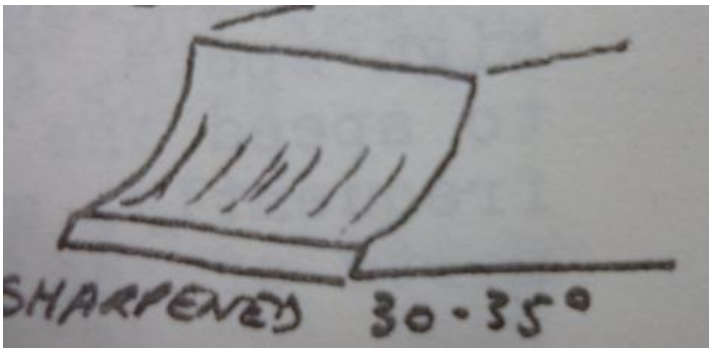


All stones should be protected when not in use. A special box is best suited to this purpose. The traditional oilstone box is made from a piece of scrap timber, as shown below. With my oilstones I've marked the end of the boxes A and B. I make it a policy to alternate the ends each time I use the stone in an effort to keep the stone as flat as possible.



Grinding and sharpening angles will vary from tool to tool, but usually are about 25^{o} - 30^{o} for the grinding angle and 30^{o} - 35^{o} for the sharpening or honing angle. The sharpening facet must be kept as short as possible and the blade reground once the facet has become too large a proportion of the grinding facet.





4.2 Sharpening Plane Irons, Chisels and Knives

The one point that tends to set back the amateur handy-person more than any other, is having blunt tools. Very few people understand how to sharpen. Indeed, I suspect that few even know just what they are trying to do! Yet, when the correct steps are followed, sharpening is both quick and easy.

Firstly though, how do you know when something is blunt? In simple terms, if a plane blade, knife, chisel, gouge etc. won't cut the hair on your arm at one pass, IT IS BLUNT! If you follow logical steps, as shown here, it is both quick and easy to fix.

In the sketch above we have an ideal plane or chisel blade. The 30° angle is called a 'grinding angle', and is produced with a grinding machine. The 35° angle is called the 'sharpening angle', and is formed with an oilstone. While the angles may vary according to the tool, the proportions should remain as shown in the sketch. Once the sharpening angle becomes a fair proportion of the grinding angle (also known as the 'grinding facet'), the cutting ability will be lost. Thus we re-grind after some eight or so re-sharpening actions.

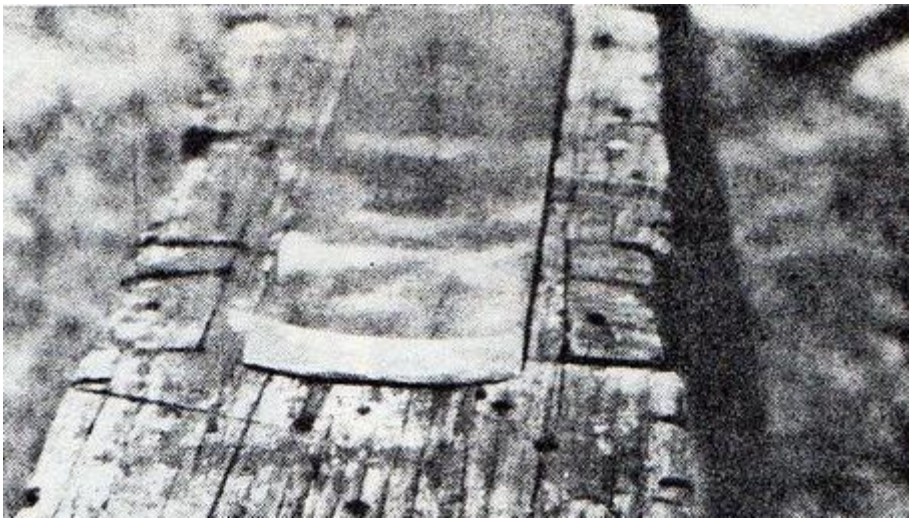
The first action with a plane is to loosen the blade from the cap iron. In Figure 1 the correct method is shown. Using a large screwdriver the bench supports the blade. If the screwdriver slips it won't go through your hand – as it would if you supported the blade in your hand.

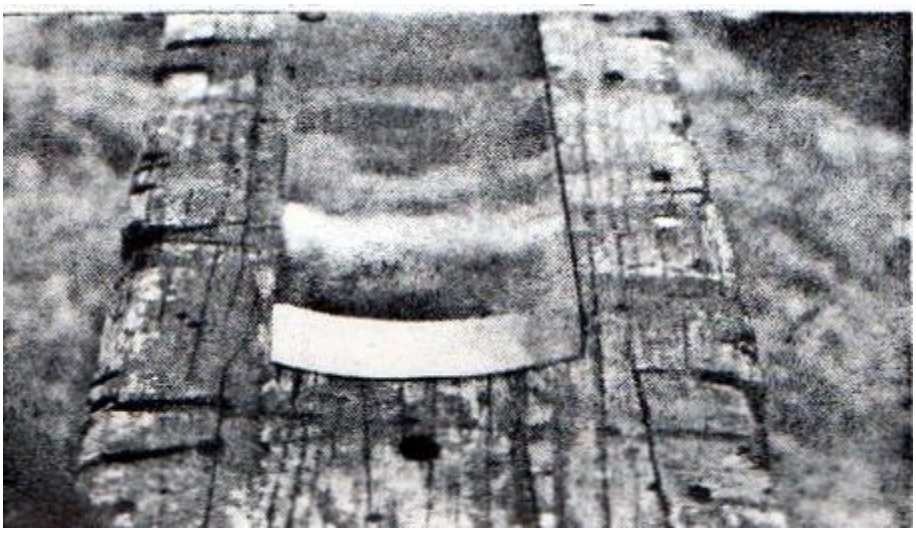
With the blade supported by both hands and with a very light action, pass the blade (from edge to edge) across an emery wheel. After every five to ten passes dip the blade in a tin of water. If you find colours appearing on the steel, you are pushing too hard against the wheel and/or are travelling too slowly on each pass. Note how my right forefinger is curled beneath the blade. This gives a depth stop so that the same amount of blade is held up to the wheel each time. Also, while Figure 2 doesn't show it, use safety glasses – every time! Slow and careful grinding should continue until all the

sharpening facet (or sharpening angle) has been removed. Remember to keep the blade cool – once the colours start to show you are removing the hardness from the blade.

Ideally, sharpen a number of blades at the one time. This is time saving, in that if you are going to stop and sharpen one tool, you may as well do several.

In the article on planes (see previous section) we looked at a number of types. Figure 3 below shows the blade from a 'German Jack'. Note the excessive sharpening facet – time for 'the treatment'. Figure 4 shows the same blade with the sharpening facet ground away on my emery wheel.



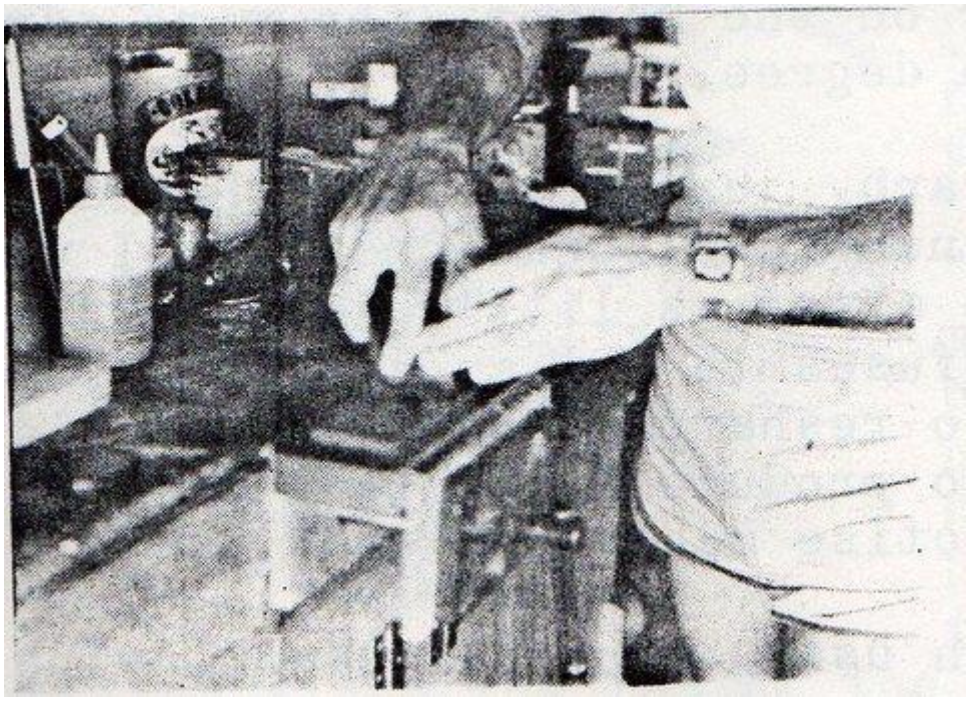


Sharpening is just as easy as grinding if you follow a set of simple steps.

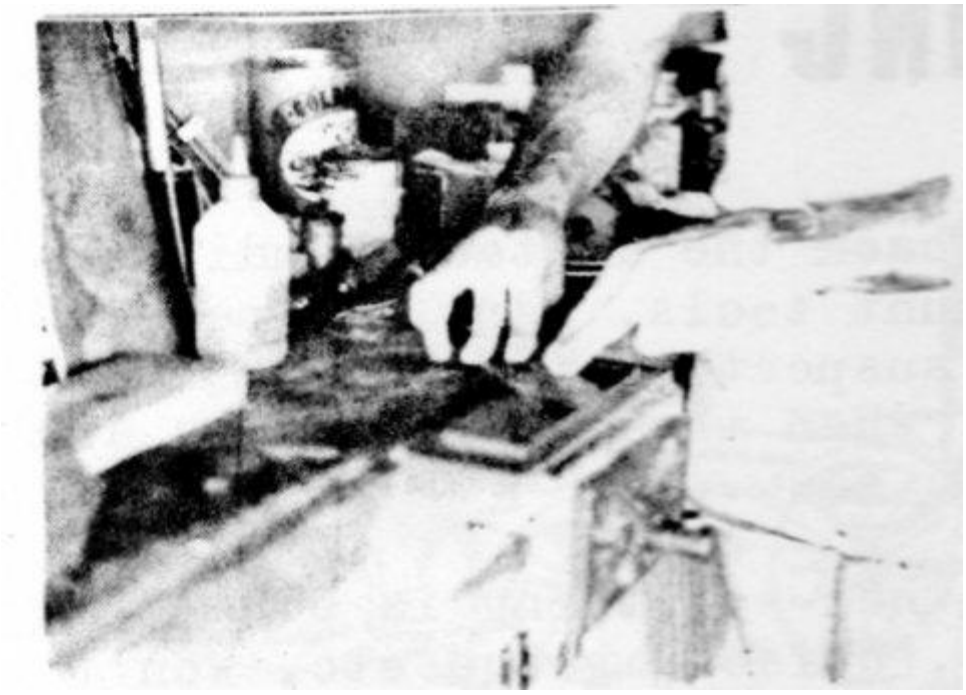
As I have mentioned before, I prefer a smooth oil stone. Most of the older stones had a smooth and a coarse side. While the same is claimed for modern stones, the smooth side is about as coarse as the fine side of the old stones. Since you don't want to remove metal so much as smooth out any scratches left from a grinding wheel, fast cutting is no advantage. One old trick was to put an oilstone in a tin of molten petroleum jelly. This filled the pores and slowed down the cutting action. While I have never done this, I think it would work well enough.

To sharpen, put the oilstone on a firm base so that it will not move. Upturn the blade s that the sharpening facet is against the stone. If you lift the end of the blade you will feel when the grinding facet is against the surface. Lift the end of the blade a fraction more, and you have the sharpening angle. To hold the blade at this angle is the trick! Years ago, I found out that if you turn the blade a bit, so that it is at a angle to the edge of the stone, rather than at right angles to the edge you can effectively increase the thickness, thus making it far easier to hold a constant angle.

The stone should be moistened with a floating solution that will lift the flecks of metal from the surface and prevent clogging. Neatsfoot oil is the best, car oil and kero are second best. (Note in Figure 5, below, how the blade is held at an angle. The plastic bottle holds neatsfoot oil).

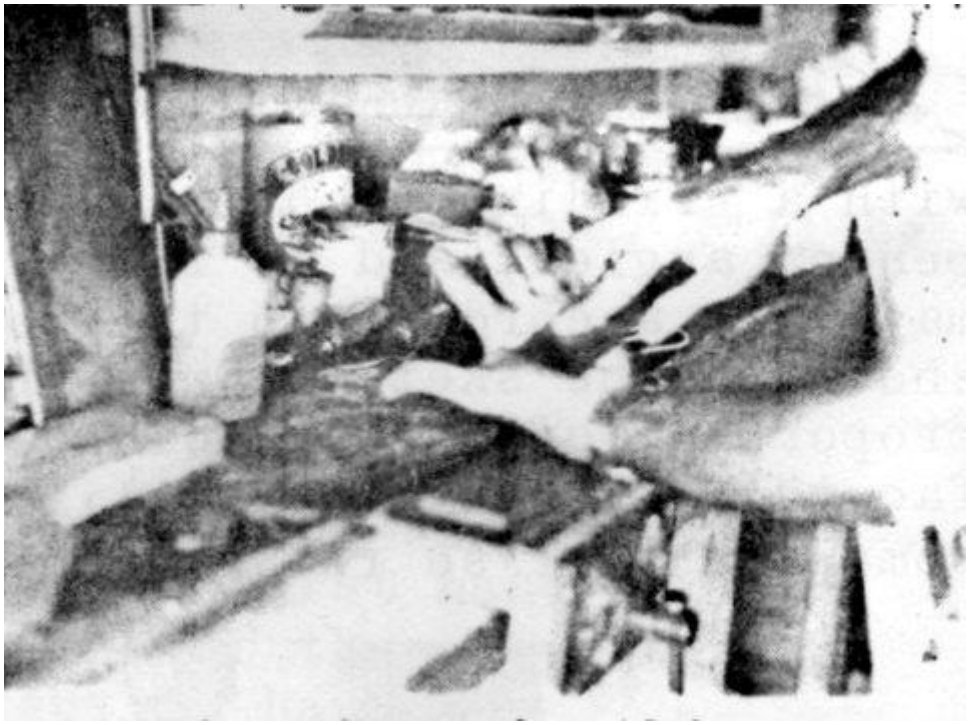


Convention has it that that the blade should be ground with a ‘figure 8’ movement. This is a good way and is one you should try. Alternatively, you can sharpen with a straight motion. Just take care to reverse the stone for each sharpening to keep wear as even as possible. With the straight motion it is easier to hold a constant angle. (See Figure 6).

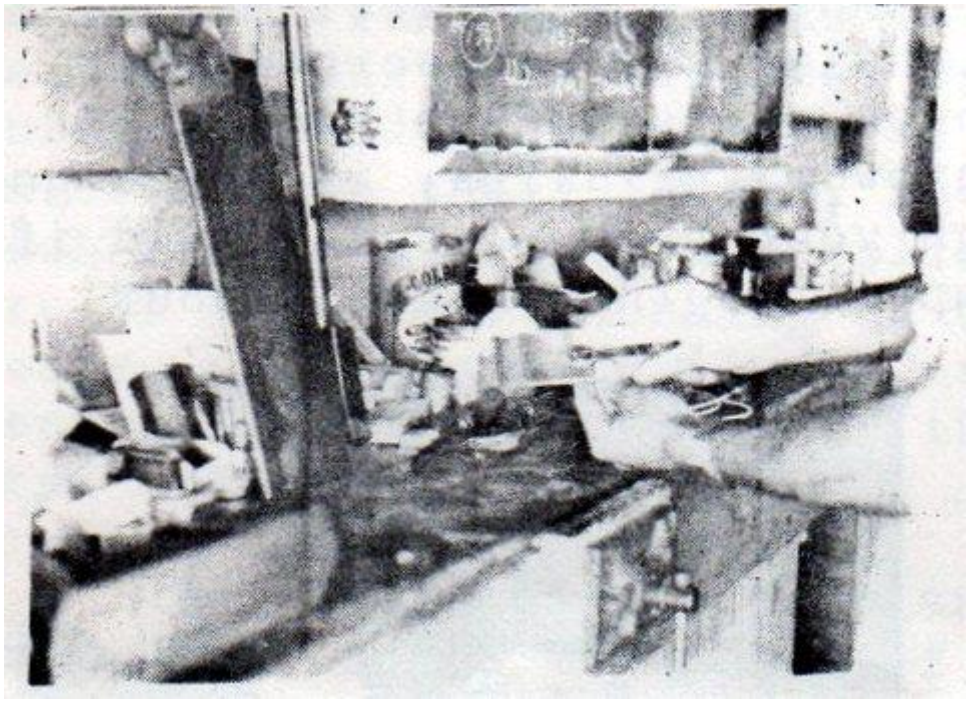


Either way, you won't need more than five or six strokes along the stone to produce a facet.

The next step is to turn the blade over, lie it flat on the stone as shown, and make several passes to remove any metal which has been bent over by the wheel. A 'wire edge' will be produced. This is a very fine strip of loose metal along the cutting edge, and it has to be removed. I usually strop the blade across my hand a few times (see Figure 7 below). Take care to pull the blade so that it is almost flat, (alternatively you can use a piece of leather, which is safer). The leather can be dressed with an abrasive compound. This will give an even finer edge, though I have never had a reason to strop this way.

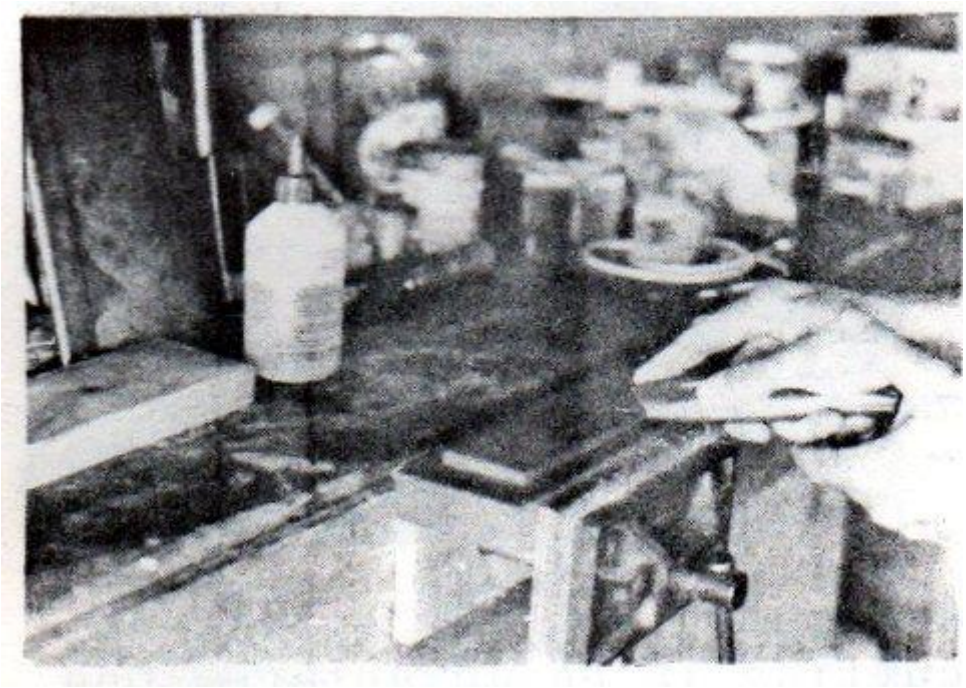


Putting the blade back together should be done carefully, to prevent damage to the newly sharpened edge. If the blade is turned at right angles to the cap iron it can be slipped on without any damage to the blade. The blade can then be turned in line with the cap iron and pulled down until the blade is just above the edge of the cap iron. (See Figure below)



The last step is to adjust the blade so that only the required amount of blade projects. Over the years I have developed a habit of running the set plane across the palm of my hand. I have learned the feel of a blade that is either too deep or not deep enough. Chisels are sharpened in exactly the same way as plane irons except that they don't need setting after sharpening. Gouges and other curved chisels require a special curved stone – a 'slip' – to remove the wire edge. Otherwise the principle remains the same. Knives are sharpened in a similar way with the proviso that grinding is usually not necessary unless you are working on a blade from which a lot of metal must be removed.

In the shed I keep a range of knives – a Stanley retractable blade, a leather knife and half a dozen homemade knives. All handy and all sharp. (I take pride in the fact that in thirteen years, I have only once replaced the Stanley 'disposable' blade, and that was after I dropped it on the cement floor! With a modicum of care (and a good stone), those blades will last almost forever.(see Figure below)



The only point to watch is that you remove equal amounts of metal from each side of the blade. Also, you should reduce pressure once you are starting to achieve a fine edge. At that stage keep swapping sides and just give the stone a couple of light

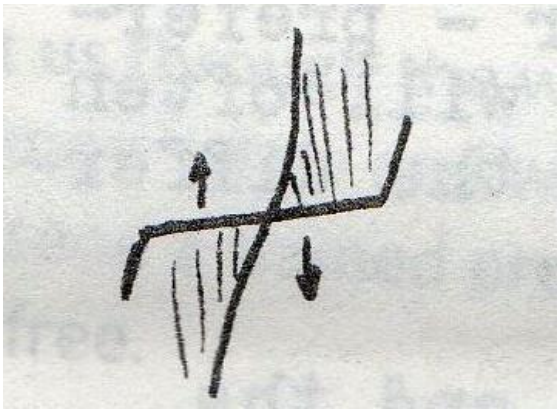
strokes. Again, the wire edge should be removed by stropping. If you are using a very fine stone such as the American 'Arkansas' stones that are starting to reappear on the market, the wire edge does not seem to form up to the same degree.

Returning to the opening paragraph, just how often should you sharpen a tool? I have found on numerous occasions that I was forced to stop and re-sharpen a blade after as little as two- or three-minutes work! Once a chisel refuses to cut a clean chip, or a plane refuses to cut, it is time to re-sharpen. Since it should not take more than several minutes to produce a keen edge, it is not a task to be avoided. Also "practice makes perfect".

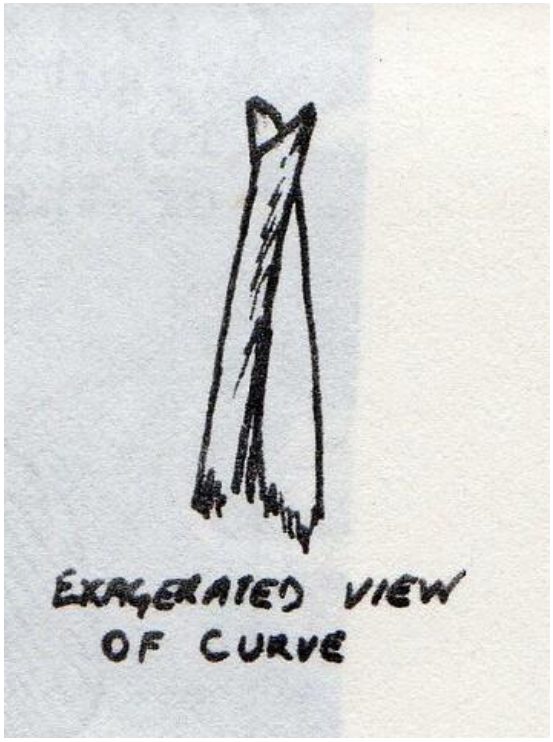
One last point – when you finish using your oilstone, wipe the surface clean of oil with a bit of cotton rag that is free of dust and grime. Keep the rag handy, and wipe over the sole of the plane from time to time, while you are planing. You will be surprised just what a difference it makes.

4.3 Sharpening Scissors

Scissor sharpening is not difficult, once you understand the principle underlying the scissors' cutting action. Scissors do not cut in the sense that a knife cuts or a saw cuts. Knives cut by a slicing action; saws cut by either a slicing action or a chiselling action (depending on whether the saw is a cross cut or rip saw). Scissors cut by shearing. In simple terms one blade moves against the other fixed blade and shears through the article between the two blades.

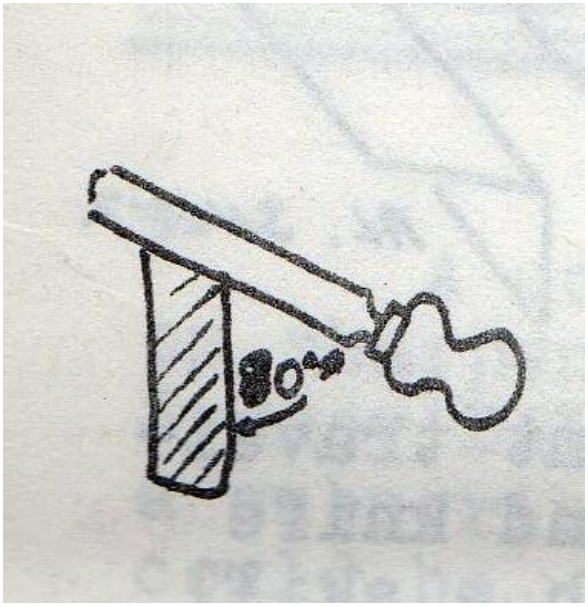


In this instance then, a pair of scissor blades are sharp at the touching edges. Sharpness is defined by the fact that the edges should be fine and not rounded over or gapped. Moreover, scissor blades are slightly curved, so that the edges bear against each other over the length of the cut. In addition, the blades are hollow ground, so that the only point of contact is the sharing edge where two blades cross. To sharpen scissors properly, it is necessary that these factors should be fully understood. I would suggest that a new pair of scissors be inspected to observe this, so you can duplicate these points on the blunt blades.



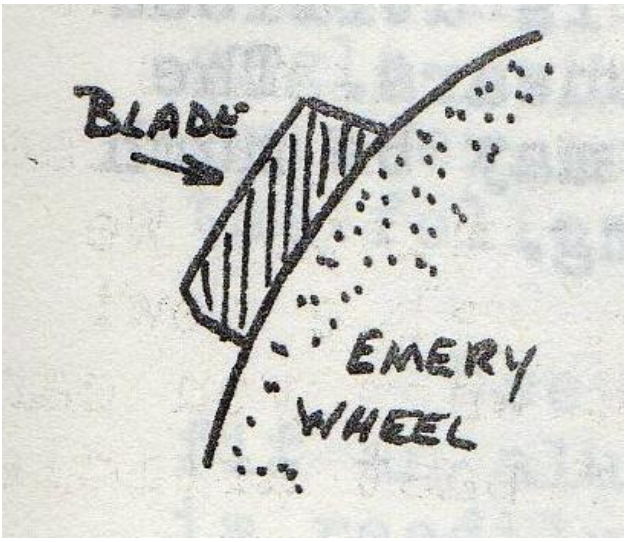
To sharpen scissors you may use either an emery wheel or a file – whichever is to hand on the occasion.

Hold the scissor blade securely, preferably in a vise fitted with 'soft jaws' (two plates of aluminium or similar soft metal across the vise teeth to protect the scissor handle) and file lightly at an angle of 75^{o} to 80^{o} from the perpendicular, across the blade toward the cutting edge, until a fresh facet has been produced for the length of the blade.



If the scissors are badly worn on the inside of the blades (and this will be shown by a shin patch below the cutting edge) it will be necessary to dismantle the blades by removing the screw or rivet on which the blades pivot.

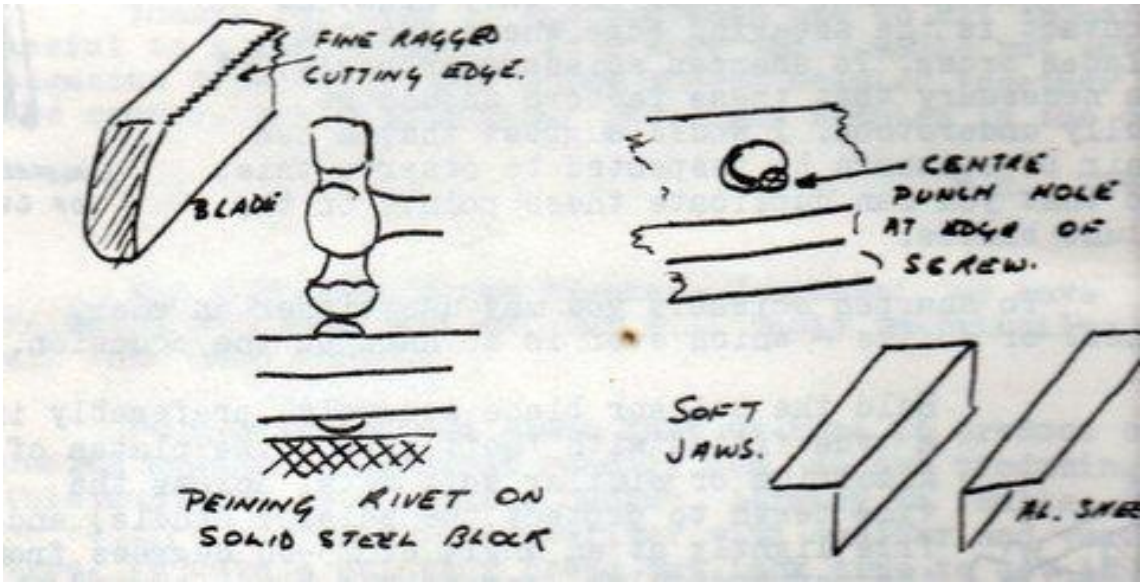
Next carefully run the blades, individually, across an emery wheel. You can't do this step with a file. I guess you could do it with an oilstone slip if you had a lot of time. This will renew the hollow ground facet.



If there is a ragged edge left after grinding and filing, it should be left unless it is too coarse. Under those circumstances lightly file with a fine file. Don't remove the burr with an oilstone as the cutting action is not as satisfactory. Scissors work best with a fine but ragged cutting edge.

Another point to check is that the screw (or rivet) is tight enough to maintain the contact between the cutting edges over the length of the blade. If the rivet is too tight the scissors will bind and they will be difficult to use. If too loose, then they won't cut. With riveted blades be careful and use a light hammer – preferably a ball pein hammer and use the ball. You will often find that just one light hammer blow will be the difference between too loose and just tight enough.

When the blades have been screwed together and the right degree of friction attained, the screw can be locked by punching with a centre-punch between the edge of the screw and the scissor.



Note: back a hundred years ago, itinerant travellers earnt a meagre living through scissor and knife sharpening. The time may come again when such a skill would once again provide a living. Especially in this age of getting someone else to do even basic jobs. You will find that sharpening is not difficult and it is worth learning, even if only to save yourself some money.

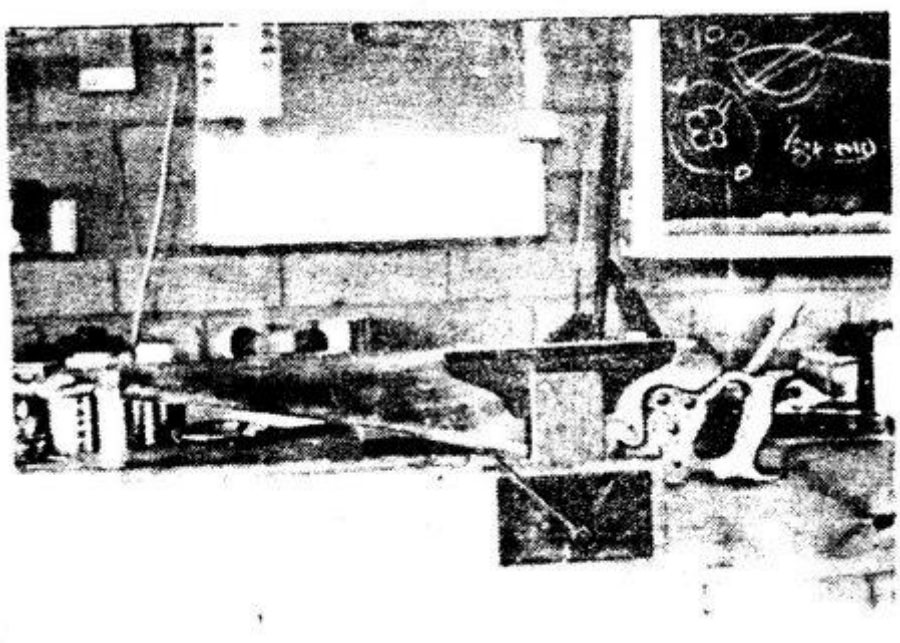
Finally, remember that the shearing action is not restricted to just scissors. The same action is utilised by shears, tin snips, guillotines, and metal shears. The sane principles apply , even though the tools may be much larger and rely more upon grinding than filing.

4.4 Sharpening, Setting and Topping a Saw

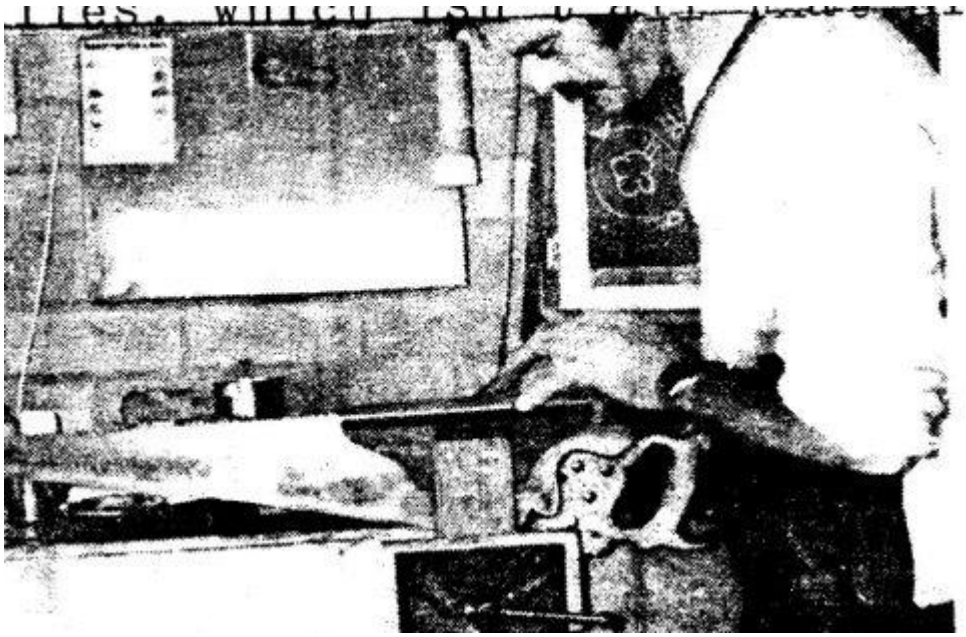
Last issue, we looked at refurbishing two old saws. To complete the job, it is necessary to resharpen them. For many, this is a process shrouded in mystery and secrecy. As you will see as you read on, this is just not the case. Sharpening saws (once they have been topped, shaped and set) should only take five to ten minutes at the most! It is a job that anyone should be able to do - once they know the very few basic rules.

The two saws that I bought for a dollar each, were in remarkably poor condition. In fact, one could go so far as to wonder just how a saw could fare so badly. The teeth weren't even close to being the right shape or height. Whoever butchered the cross cut saw must have been a real drongo. No matter – it served my purpose, as I can show just how it should be done.

The first step with really badly sharpened saws, is to "top" the teeth. To do this you need a steady support and I would most strongly recommend you making up a saw sharpening vise (see next section). It is well worth the small amount of time it takes to make a good one, and it will last generations.

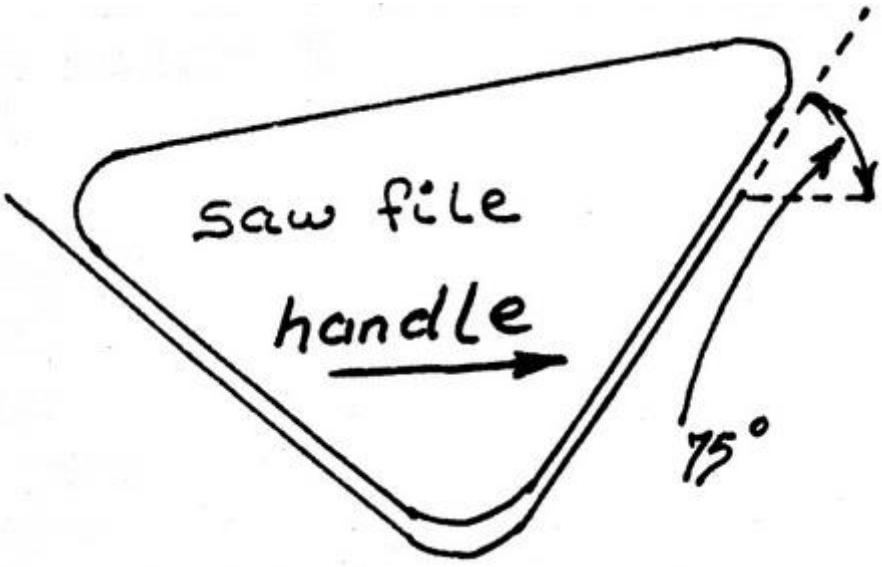


I selected the longest medium cut (mill saw) file that I had in the cupboard. I pulled off the plastic handle so that the file could lay flat along the blade. (plastic file handles are a real boon, as they can be fitted and removed frequently, without affecting their grip on the file tang). Note* whenever I buy a new file, which isn't all that often, I mark the end of one side with a felt marking pen. That tells me not to use that side until the other side is worn out – or unless I need a sharp file for a specific purpose. In this instance I didn't need the new side, but it is a small point worth bearing in mind.



With just a few minutes work, and by pushing the file the full length of the blade, I had filed away all the high teeth. I didn't stop until the file was just starting to touch on the tops of the lowest teeth. At this point I had filed some teeth down to the bottom of the gullet. No matter, I'll never have to top the saw for as long as I continue to sharpen it! If you have to file some teeth completely away, do so. Then at least you will be starting off on the right foot. After that you can compensate for any slightly higher teeth each time you re-sharpen.

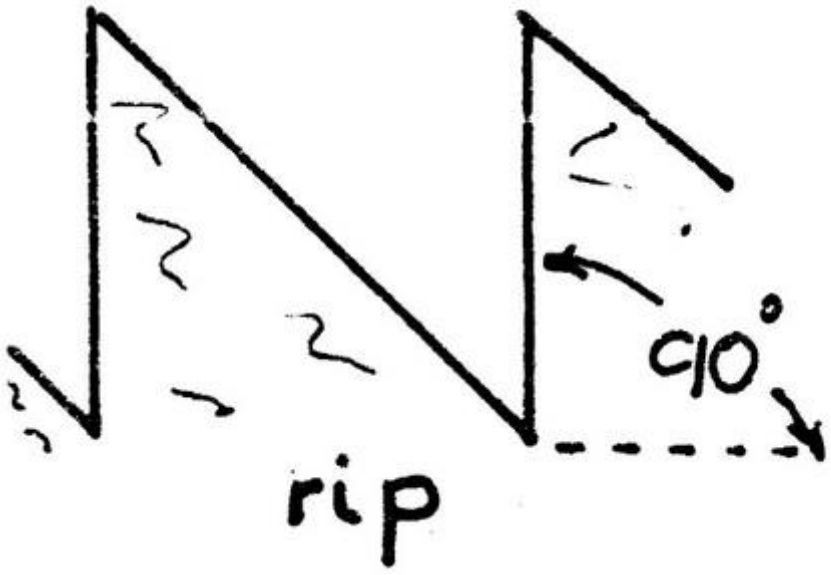
The next step is “shaping”. This is simply a matter of filing in the teeth again, till they are evenly spaced, and of equal depth. The only difficulty here is when you have completely cup teeth away during topping. I do it by eye, and find that is accurate enough – I doubt you’d be out by much more than a couple of thou (Thousandths of an inch) if you go carefully. In the sketch below I have shown the angle at which the file must be held to get the correct shape for each tooth. All the teeth should be of an equal depth, and the same shape. To do this, it is quite likely you will need to cut away more of one side of the tooth than the other. In the sketch above I have shown what could be a typical section of the blade. One tooth the desired depth, the rest need to be filed down to the dotted line to conform. Obviously it is not just a question of filing madly, but applying pressure to one side of the file to “pull” the tooth across to the desired place. Study what you are about to do before you start!



If you have had to file away a number of teeth, it is far better to start off each gullet and mark out the blade. Then go back over each tooth again. I filed in each tooth by working down the length of the blade four times, before I had them all at the correct spacing and depth.

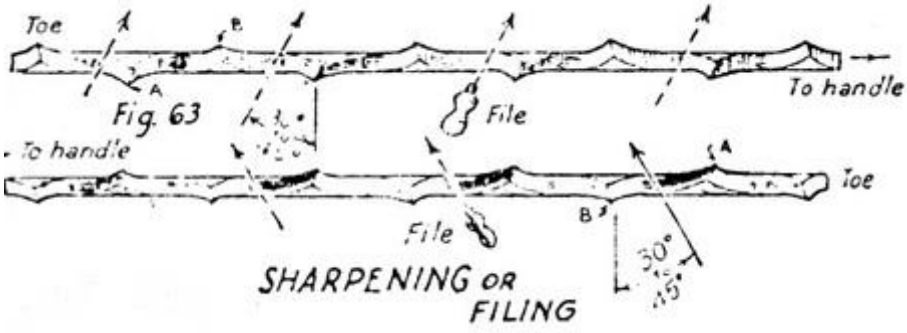
When you are satisfied with the shape, you are ready for setting. Before you can set you need to know the number of teeth per inch. If you set a rule on top of the teeth, and then count the number of points between any two inch marks, you will know how many points per inch the saw is. My saw is 6 points per inch. The saw set was then adjusted to “6” on the little circular anvil, and I set every second tooth (having, of course, first determined which way the teeth had previously been set).

The saw set bends the top half of the tooth away from the operator. Once you have worked you way down the entire length of the blade, setting every second tooth, turn the saw about and set the alternate teeth. When you have finished, each tooth top should point away from the tooth on either side. If you were setting a rip saw, you could stop at this point, as the job would be done. Note* Rip saws are filed at 90°, as shown in the sketch below. They are a nice and simple saw, and should not take more than 5 minutes to touch up – so why put off such an easy job?



Anyway, back to cross-cuts. The last step is to sharpen the teeth. This is both simple and easy, but it requires a bit of concentration, and a steady hand (not to mention a sharp saw file). However, before I go any further, I would like to digress a bit. In sharpening, you will have to file every second tooth, and then turn the saw round and repeat the procedure on the teeth that were untouched. Nothing difficult about it – except that usually the phone rings or "it's time for a cuppa", or something. I always keep a felt marking pen handy. If I get interrupted, I can easily mark the last tooth done, and then pick it out at a later date. On big teeth this is not quite so important, but on small saws which are frequently sharpened, it can save a lot of trouble and unnecessary eye strain.

On the sketch on the below you will see that sharpening is divided into two sections. You can start from either end of the saw – that is up to you. All you have to do is pick which side of the tooth you are supposed to file. The basic rule is that you always file away from the back of the tooth that is pointing away from you. At the same time, you will be filing off the back of the tooth that points towards you. Simple, isn't it!



Two little tricks of the trade. Firstly, always stand at a 30 degree angle to the saw. That way you just file normally and the angle will always be constant. Secondly, always file the same number of strokes for each tooth. That way you will remove the same amount of metal each time and should NEVER need to top a saw again. (I've been the same saws for nearly 20 years, and have never topped one even once).

Also, lift the file slightly, on the return stroke. This will greatly extend the life of the file, and produce far sharper saws.

You can tell whether a tooth is sharp, simply by looking at the point. If you can see a tiny spot of reflection (it almost looks like a ball of light), then it is blunt! The teeth at each end of the blade rarely get used. When sharpening you may find that just two strokes of the file will remove the light spot. I'd suggest that you make at least four strokes, even though the teeth don't need it. Then, when you get down to the middle of the saw, (still using the same number of strokes), you will be cutting away the amount of metal necessary to properly sharpen each tooth. If you find the necessary number of strokes is not sufficient to remove the light spot, go right along the saw on the first number. If a number of teeth are still blunt, do the entire saw gain – maybe three strokes per tooth. When I do a saw I don't worry if a couple of teeth aren't perfectly sharp, since I know that I'll be resharpening after only a couple of hours (or less), and that I will pick them up next time. Once a point is blunt it won't cut, and the rest will soon come down to the same level. (As I said before – I've never had to top one of my saws yet).

Bear in mind that the more you file, the sooner you will be faced with re-setting. This is no problem, but it does show that you have removed metal that can never be replaced. Also, the saw is that much closer to the day when you will have to throw it away as being of no further use. Better to leave the odd spot of light on the point!

It is my opinion that to do something properly, you should know why you are doing it! Teeth are set so that the cut (it is called a "kerf"), is wider than the saw blade. This prevents friction and fouling of the blade in the kerf. By bending each tooth out half a tooth thickness, you make a kerf that is twice as wide as the blade is thick. Thus we don't set a saw just to impress the neighbours, but to make it easier to push.

As I said before, rip saws are filed across the blade. Each tooth acts as a tiny chisel, and chisels out a shaving. It is best used cutting with the grain, not across.

Rip saw teeth, being sharpened both sides, act as knives and sever the timber fibres. They always work best across the grain, when they can slice through the wood fibres. Rips are best used on ply and Masonite.

Sharpening saws should be both easy and quick. The first few may take a bit more time, but with practice comes skill. I see no point in spending $6 to have a saw done professionally, when I can buy a saw file for less than $2. (Early '80s pricing. These days finding anyone who can sharpen your saw professionally is a neat trick!)

4.5 Making a Saw Sharpening Jig

Back in the day when we sharpened wood saws rather than buying a cheapie and tossing it out when it became blunt, you used to be able to buy a device called a saw clamp to keep your saw steady while you went about sharpening it. Unfortunately, I haven't seen one for sale for many years, even second hand and I'm not sure that most people would know what it was if they saw it!

However, being able to keep your saws sharp makes your working with wood easier and much more enjoyable as well as extending the life of your saws by many years (thus saving lots of money) so it is a worthwhile skill to learn. Also, having a piece of kit that makes the job easier by keeping the saw held firmly but with the teeth still accessible is a good thing to have too and this article will show you how to make one for the cost of a hinge and some screws.

The timber that I used was straight off a hardwood pallet; it is amazing how well they come up after planing the top, rough layer off!

To make the saw sharpening vise you will need the following timber

a) 2 pieces 200mm x 93mm x 20mm
b) 2 pieces 100mm x 93mm x 20mm
c) 2 pieces 280mm x 65mm x 20mm

Really, the width and thickness can be pretty much whatever you've got so long as the rough shape is the same, these sizes worked for me and are designed around what I got off the pallet and I was able to get all the bits from one of the 1200mm boards off the pallet.

After pulling the board off the pallet and removing the nails, it was a comparatively simple matter to plane off the rough outer surface of the wood to give a nice finish and I used my faithful jack plane to do the work.

Then it was an easy matter to use my crosscut saw to cut the board into the various lengths, I then glued one each of piece b) to the end of each piece a) so that the board was double thickness at one end and single thickness at the other. Using a wood rasp and some fine sandpaper I rounded off the outside ends of the longer board to make it look pretty.

I then took the third set of pieces (c) and cut the long axis down from the standard 93mm wide to 65mm wide. These were to be the jaws of the vise that would hold the saw steady while it was sharpened and so would need to be cut to shape. They are tapered at each end; I measured off the centre of the board's long axis and then measured in 50mm each side of the centre line and then drew a diagonal line to the opposite corner. Cutting along each of these lines gave me a piece of wood shaped like a long narrow trapezium.

On the long axis or base of the trapezium I measured 30mm down along side and 10mm in along the edge and drew lines along to help me keep straight, then planed away the material inside the line to give a chamfered edge. This was to be the outside surface of the jaws. The inside surface of the jaws I needed to taper from the short side of the trapezium up to the long side of the trapezium such that there was a thin surface of wood to grip the saw blade, so I pared it down with my faithful jack plane. This was a lot easier and more fun to actually do than it sounds when I describe it!

Once this is done the vise can be assembled. I got a large, economy sized hinge and screwed each side to the thickened end of the part a/b assembly using screws that were long enough to go through into both pieces. If you are concerned about the wood splitting, predrill the holes first with a drill small enough to allow the screw threads plenty of bite. I then screwed the jaws to the other end of the assembly. (I tried to describe how I did it detail and realised it made no sense at all, so look at the photos...) To use the vise, put the saw in so that the teeth come up just above the jaws and then place the whole thing into a wood workers vise and tighten it up on the saw vise. It will hold your saw nice and steady while file the teeth sharp.

5.0 Hardware and Consumables

5.1 DIY Animal Glue

The majority of glues in use today – epoxies, cyanoacrylate “super glues” and even the humble PVA white wood glue are all made from petrochemicals using industrial processes that would be impossible, or at least very dangerous, to try and replicate in the home. If you are looking to be more sustainable in your choice of glues there are a number of options that are still available to you that can be made using “kitchen table” technology and from reasonably local raw materials. This is the first of those choices – Animal glue.

Animal glue can be made from animal (usually cow) hide, bones, hooves and horns, glue can even be made from fish skins although that is generally referred to imaginatively enough as “fish glue”. The bit we are after is collagen which is also sometimes referred to as gelatine. In general terms the collagen is extracted by boiling in water and then concentrating by boiling off the excess water and casting the glue into sheets, which are then cut up for future use.

The Raw Material

As the raw material you could see if you can hold of the more traditional hooves and horns or even perhaps a cow hide from somewhere but for a first time it is easiest to work with rawhide and rawhide is easily available to us urban dwellers in the form of rawhide dog bones. These tasty (I assume) dog treats can be had from pet stores, some supermarkets and even your local butcher may come up with them. The whiter the colour of the rawhide, the paler the glue that comes out in the end. You can also use just about any raw animal skin so you could use rabbit or roo of you can get hold of it freshly killed.

The Process

Find a decent sized pot that will hold the rawhide, with some allowance for swelling as it absorbs the water. The rawhide bones will unravel as they soak up the water too so a bit bigger is better than a bit smaller. To get the water into the rawhide it is best to cut it up but dried rawhide is pretty tough stuff so the easiest thing is to do is to boil it for half an hour then cut up the softened rawhide with scissors.

We have a wood burning so I set it going and put the pot on to simmer while Linda was out one day. As it turned out, this was a good thing! The boiling rawhide gives off an aroma redolent of very old, very dead, socks. The smell starts off light but after a half hour or so it graduated to gag-worthy and permeated the whole house. Needless to say this is one job that should be done outside; although in my case I was able to get most of the cooking done, get the stuff transferred to the garage and the house aired out before she got home. This prevented any body odour and flatulence jokes at my expense.

The rawhide needs to simmer for a good long time, 3-4 hours to extract all the goodies so a low grade heat source is good, like a wood stove, but most of us don't have one so whatever you have would do. If you were going to use a rocket stove the high heat they develop might be a problem so it would be best to use a double boiler, especially near the end of the process. You will probably need to top the pot up with water as it boils off anyway, so keep an eye on the level and how thick it is getting. The mix gets very thick towards the end anyway and you have to be careful not to burn the bottom, stuffing the glue and making it very dark.

Once I had boiled the stuff enough I used a pair of tongs to pick out the remaining solid rawhide for composting, and then poured the liquid glue into a steel pan. I lined the pan with baking paper first to ensure it released easily but I suspect that it would have come away easily enough as it was and the baking paper was not necessary.

I left it until the next morning, at which it was a floppy brown mass and I removed it from the container, cut it up into squares about 1 to 2 cm on a side and left it sitting on the bench to finish drying. Once completely dried the glue was quite hard and would probably have lasted quite a long time if stored in a cool, dry dark space. Remember that it is a form of animal protein and may attract mice or cockroaches etc so put it in a sealed container.

Using the Glue

To remelt the glue it is best to use a double boiler for a couple of reasons, it stops the glue burning onto the bottom of the pot but also the heat in the water keeps the glue molten and ready for use. That is why here was glue boiler in the old wood working shops, so it was ready for use when required. I put all of the glue into the inner pot of my old cast iron glue boiler and then added just enough water to cover the glue squares. I put the whole thing on the heat and it only took about 30 minutes to get to a usable consistency although I did give it a stir every 5 or 10 minutes or so.

Once the glue is properly dissolved, to use it all you need to do is get the pieces of timber to be joined, paint both mating surfaces with a good layer of glue, and then apply pressure with a wood vice or cramps. Leave the glue to set over night and you should have a good solid bond in the morning. This type of glue is not waterproof and so should be kept for indoor applications only.

Keeping a lid on the inner pot prevents too much water evaporating when it is hot, when finished gluing just remove the pot from the heat and the glue will solidify again. To reuse it just put it on the heat again and if the consistency is too thick and gluggy* add a bit more water and give it a stir.
(*technical term)

5.2 The Box o' Bits

Back when I was growing up in the '60s there were times when things were tough and money was short and we had to be frugal, not through any sense of environmental awareness or desire to be more sustainable but through sheer need. My father and brother were both skilled technical men and I picked up habits from both and one which developed out of our need to be frugal I still carry on to this day – the box 'o bits! Inevitably stuff breaks and can't be fixed so it has to go out, but before it goes out it was our custom to pull whatever it was apart and remove any nuts, bolts, split pins, brackets, screws or what have you and then the carcase thrown in the bin once all useable parts had been removed. These parts were then added to the box 'o bits which then acted as a store of consumable when we were repairing other stuff or working on

projects. Surprisingly enough, I almost always seemed to be able to find what i needed in the box ‘o bits, and even if I couldn’t, I could usually find something I could bodge up to do the job.

In those days also there was very little in the way of shops open on the weekend after midday on Saturday so if you were working on a project or repair on a Saturday afternoon, as we often seemed to be, the box ‘o bits became out spare part supermarket. Today, the shops do open for longer hours so supplies are not so time critical but the good old box ‘o bits can still save time, petrol and money by removing the need to rush out and get those pesky missing bits.

Almost any box will do to start, but a lid is handy to keep rubbish and insects out, ideally an old toolbox you don’t need any more can be repurposed to be your box ‘o bits. If you use your box diligently, it is highly likely that you will need to get a bigger (or second) box as the years go by so keep that in mind before you throw any other good strong boxes out.

If you are really, seriously organised you can also get one or two of those boxes of drawers to sort out any of the bits where you have lots of the same thing. It does make things easier to find, but somewhat diminishes the thrill of the hunt!

That’s all there is to it, so why not start your own box ‘o bits today?

6.0 Safety - Personal Protective Equipment (PPE)

"I'm no woosie , I don't need safety equipment !" - In industry this attitude is slowly being turned around as companies focus on occupational health and safety. New designs of safety equipment and appropriate training are helping to raise our awareness of safety in the work environment. It is a different matter in the home though, where many of us either don't think about it or regard wearing safety gear as a bit sissy.

When an accident occurs at work there is usually enough equipment and trained people to hold the fort until the ambulance arrives, and that may be as short a time as 5 to 10 minutes away. In a survival situation we are on our own resources, no complex medical technology to make us well and precious little back up to keep things running while the injured party recovers. It is therefore of prime importance to protect ourselves against possible accidents and to think and act in a safe manner. In this case especially, prevention is better than cure.

If you cultivate safe habits now it will make it easier to remember when you really need to and reduce your risk of being injured before the wheel comes off the wagon.

Eye Protection

As the saying goes - "Only two to a customer!" . Eye injuries are very traumatic, very difficult to home treat, and should you lose part or all your sight due to accident your survival options are severely reduced. Eye injuries can occur as a result of flying particles of dust, sparks or metal; chemical splashes or radiation such as the intense ultraviolet light given off during arc welding. Many workshop and garden activities are hazardous for the eyes so keep some form of eye protection handy at all times.

There are several types of eye protection worth considering: -

1. **Safety Spectacles** - These should conform to the face as closely as possible to reduce the risk of particles or splashes bypassing the spectacles and getting into the eye. The most common material of construction is polycarbonate type plastic and although they are light and cheap they provide excellent protection. More expensive models have metal frames with polycarbonate lenses and side shields, they are heavier than the entirely polycarbonate type but will last longer. If you wear prescription spectacles, you should wear safety goggles over the top of them or get a pair of prescription safety glasses with toughened glass or polycarbonate lenses, standard prescription glasses are not good enough.

2. **Safety goggles** - These give much better protection than safety glasses as they entirely enclose the eyes. They are less comfortable to wear for extended periods of time, however, and can fog up during hot work . A good policy is to have a pair of safety specs for general use and a set of goggles for particularly hazardous work.

3. **Face Shields** - These protect the whole face during very hazardous work such as diluting battery acid or making black powder. The are not 100% eye protection though and should be used in conjunction with either safety specs or goggles.

Generally speaking, eye protection should be comfortable to wear and give good coverage for the eyes, so you might need to do a bit of looking and trying on before you find a pair that suit you. El Cheapo eye protection is false economy, it could let you down when you need it most. Any eye protection that you buy should state on it that it conforms to Australian Standard (AS) 1337 and/or have a Standards Australia Approved sticker on it. Your sight is too precious to gamble with.

Head Protection

This is the so-called "skid lid”; "crash hat" or "brain bucket" that can protect your most vital asset against knocks or blows. Obviously if a pallet load of bricks falls on you a safety helmet is not much use, but it can keep your head intact if your mate on the roof accidentally drops a hammer on you.

Head protection is mandatory if you are felling timber in the bush or in building or repair work where there are people working above you. The modern safety helmet is constructed from that light, strong plastic polycarbonate so they are also light, strong relatively cheap and durable. They can stand quite heavy impacts but one such impact usually renders the helmet unsafe, and it should be replaced. They also deteriorate to the point of being unsafe when exposed to: excessive heat such as on the rear parcel shelf of the car, petroleum products, cleaning agents, paints , adhesives and some aerosol sprays .This deterioration may not be noticeable to the user so treat your safety helmet with care and inspect it regularly for visible signs of breakdown . The shell should last up to three years in service and the harness inside the shell should last up to two years.

Safety helmets are available which have fittings for attachment of face shields and earmuffs directly to the helmet, which increases the versatility of its protection. Also, any helmet or fittings that you buy should conform to the relevant Australian Standard such as A.S. 1801 - 1981 for industrial safety helmets.

Foot Protection

Even so simple a task as mowing the lawn can have serious consequences for our feet, yet how many people do you see wearing thongs while doing it? The steel capped safety boot or shoe is without doubt the most popular and accepted piece of safety gear used in industry today, even so many people do not translate good work practices into good home practices. Working with hand or power tools, welding, mowing the lawn, moving rocks, cutting or felling timber or even working with horses or cattle all provide opportunities for foot injury. So, a pair of safety boots or shoes is essential for working around the house or farm. Gum boots are also made with steel caps, and they can prove invaluable around the farm.

When buying safety footwear two rules apply:

A. Try before you buy – so you are sure that they are comfortable and suit you with the result that you are more likely to wear them and,

B. Ensure that the footwear conforms to Australian Standard 2210 for safety footwear.

Ear Protection

Industrial deafness is an insidious disease that creeps up on you, resulting in a degree of hearing impairment before you realise the danger. Around the house or farm the danger to our hearing may be even less obvious, coming in the form of chainsaws, brush cutters, lawn mowers and electric power tools like angle grinders , routers or planers . Of course, hearing protection is always required when discharging a firearm.

There are two forms of hearing protection commonly in use -

1. Earmuffs - These are foam cushioned plastic cups which cover the entire ear, shutting out the noise in the process.

2. Ear Plugs - Are either disposable or reusable plugs which are inserted into the ear canal blocking out noise. The reusable ones are advisable unless you can store a good supply, but provision must also be made to be able to clean, disinfect and store the reusable ones in a clean state.

Whether you choose plugs or muffs depends on personal preference as one is roughly as effective as the other, depending on variations between individual types.

Hand Protection

Our hands are the two most valuable tools we own so it makes sense to protect them. Gloves are an obvious way but another handy (if you'll excuse the pun) method is to put away a supply of barrier cream. This will protect your hands when you're using cleaning

agents, petrol, solvents, oils and greases or even if they are immersed in water for any period .

Gloves are a good way to protect your hands from damage or irritation while carrying out 1001 jobs around the house or farm. There are many different types of gloves, the most common are listed below –

- Cotton - These are usually made of white cotton with a blue elasticised wrist. They are useful to keep the hands clean and warm in cold weather or as a liner for a larger glove, and not much else.
- Leather - The ones commonly available are a grey chrome tanned leather, they give protection against the heat and radiation of welding and against abrasion of the skin caused by coming in contact with rough surfaces such as rocks or bricks. Leather gloves give no protection against liquids and if they become wet, they will lose their insulating power and will not protect against heat until they have dried out.
- Acid Resistant - These are made from red PVC which has been applied to a cloth backing, they are large and can be a bit awkward if you have small hands. These gloves protect against water-based irritants such as battery acid, caustic soda solutions or strong detergents and have a limited resistance to solvents.
- Rubber Latex - Gloves are also for use against water based irritants but are less resistant than the thicker PVC gloves and tend to tear more easily.They are cheaper though and give a finer sense of touch .
- Nitrile Rubber - are resistant to solvents such as petrol, kerosene, paint thinners and mineral turps. They can be difficult to find but are available from safety equipment suppliers.

SUMMARY

It is in the best interests of yourself and your family to have the correct safety gear for the job and follow three simple rules -

1. Make sure your safety is comfortable and fits you well.
2. Check and maintain it properly.
3. USE IT!

When buying safety equipment make sure it conforms to the relevant Australian Standard and is so marked, if the supplier cannot demonstrate the standards approved label go elsewhere.

7.0 Resources

7.1 Books on Tools and How to Use Them

Traditional Woodworking Hand Tools – Graham Blackburn – BT Batsford Lt (UK) 1999 ISBN 0 7134 8508 6 – This is a wonderful book which goes into the history, construction and use of a whole variety of woodworking tools. It covers holding tools (eg vises), setting out tools (eg bevels, squares and gauges), sawing tools, has a large section on planes (over 150 pages), edge tools, boring tools and miscellaneous tools (eg hammers). No photos but lots and lots of line drawings. If you have an old woodworking tool but don't know what it does, this book is for you!

Selecting and Using Hand Tools – Editors of Fine Woodworking Magazine – The Taunton Press (US) 2005 ISBN 1 56158 783 4 – This book is a series of articles from Fine Woodworking magazine so there is not a great amount of depth on each tool but some really great information on using, maintaining and in some cases making, the tool in question. Subject covered include buying tools; some essential tool techniques; marking and measuring tools; edge tools; handsaws and shaping tools. There is also a section on making and modifying tools. Lots and lots of colour photos.

Choosing and Using Hand Tools – Andy Rae – Lark Books (US) 2002 ISBN 978 1 60059 274 4 – The book starts off with how to acquire, store and maintain you handtools, then goes on to discuss how to use holding tools (including benches); laying out tools; striking tools (including hammers and axes); pulling prying and twisting tools; boring tools; scraping and chiselling tools. Also covered are edge tools which include draw knives and spokeshaves as well as planes; and the various types of hand saw. There are LOTS of colour photos.

Making and Mastering Wood Planes – David Finck – Sterling Publishing Co (US) 2005 ISBN 1 4027 2022 X – As you would expect, this is a book about planes! It starts out talking about the tools and materials needed for plane making including the parts of a plane. The book the cover what hand tools to use to make the plane, how to sharpen the various types of plane irons, than the techniques of making the plane itself. The

techniques of using a plane are covered as well as planing aids and special techniques and scraping techniques as well. The book does have some line drawings but mostly colour photos.

Japanese Woodworking Tools – Toshio Odate – Linden Publishing (US) 1998 ISBN 978 0 941936 46 0 – Japanese woodworking tools have a long history and are somewhat different to their European equivalents. The book goes through the fittings and fixtures of the Japanese woodworking shop and how they are set up. It then goes through the types of tools in each section and how they are used. There are sections covering marking tools; saws; chisels; planes; axes and adzes; hammers; gimlets and knives. There is also a section of tool sharpening stones and techniques. Lots of lne drawings with some black and white photos.

The Tool Book – William Bryant Logan – Smith and Hawken (US) 1997 ISBN 0 7611 0855 6 – As a change of pace, this one is all about garden tools. The book covers tools by their usage – digging tools; cultivating tools; propagating tools; planting tools; cutting tools; watering tools; composting tools and then covers holding and hauling tools, raking and sweeping tools. The book also covers safety clothing and protection and the care and storage of tools. There are lots of full colour photos of some unusual and esoteric garden tools.

How to Make Twelve Wood working Tools – Aaron Moore – Intermediate Technology Publications (UK) 1986 ISBN 0 946688 53 2 – This book is basically what it says on the box: it gives you the techniques and process for low tech production of twelve tools. The tools covered are – try square; bevel square; marking gauge; cutting gauge; mortise gauge (2 versions); panel gauge; mallet; bow drill; bow saw; coping saw; fret saw and hack saw. Fascinating stuff! Lots of good-sized line drawings.

For more books on making your own tools I suggest you consult the section on Blacksmithing books (see below)

Saws and Sawing (No10 in the Workshop Practice Series) – Ian Bradley – Special Interest Model Books (UK) 2005 ISBN 0 85242 887 1 – All you ever wanted to know about using and maintaining wood and metal saws. The book starts off with sharpening, topping and setting saw teeth then goes through the use of wood saws but the majority of the book deals with metal saws including hacksaws, fretsaws, jigsaws, cold saws, bandsaws and finishes off with the brazing and welding of bandsaw blades. Lots of line drawings and black and white photos.

Drills, Taps and Dies (No12 in the workshop Practice Series) – Tubal Cain – Special Interest Model Books (UK) 1986 ISBN 978 0 85242 866 5 – This book covers metal working tools and processes: twist and other drills; drill sharpening; drill chucks; screw threads; taps and dies; hand tapping; screwing dies and tap and die sharpening. Some charts, line drawings and black and white photographs.

Making Small Workshop Tools (No 12 in the workshop Practice Series) – Stan Bray – Argus Books (UK) 1987 ISBN 0 85242 886 3 – The book focuses on small metal working tools such as marking out tools (eg scriber and centre punch), benchwork tools (eg drill clamp, filing plate and pin chucks) and lathework tools (eg knurling tool, box tool and filing rest). Lots of blackand white photographs with some line drawings.

The Scythe Book – David Tresemer – Alan C. Hood & Co. Inc. (US) 2001 ISBN 0 911469 19 2 – This book covers every possible thing you could ever want to know about the scythe. It covers the parts of the scythe, how to peen and sharpen the scythe as well as the technique for using the scythe to harvest hay and small grains. The second half of the book is an addendum by Peter Vido which also covers blade selection, field honing and repairing the damaged blade as well as new insights on sharpening etc. Some black and white photos and line drawings.

Woodwork Tools and Their Use – Walter Coventon – Hutchinson's Scientific and Technical Publications (UK) 1953 ISBN (No ISBN) – This book has a chapter on every type of woodworking tool you can name, as well as a few that I've never heard of (like papering sticks and "the mouse" – nothing to do with computers!), all the usual

suspects are there too. There is good detail about using and maintaining each of the tools listed. The book is mostly text but there are some line drawings and black and white photos as well.

Old Ways of Working with Wood – Alex Bealer – Castle Books (US) 1996 ISBN 0 7858 0710 1 – This one goes right back to felling and splitting the tree, then covers the work bench, sawing, hewing, boring, chiselling, shaping, planing, turning and miscellaneous stuff. Each section gives details on what the tools looked like and how they were used with lots of line drawings to support the text (the dust cover says more than 200 illustrations, but i haven't counted).

7.2 Books on Blacksmithing

The Modern Blacksmith – Alexander Weygers – Van Nostrand Reinhold (US) 1974 ISBN 0 442 29363 1 –This is one of THE books on blacksmithing. It tells you how to set up your equipment and how to make a good load of it, it talks about the processes used in blacksmithing and covers some simple projects to try. A great book!

The Making of Tools – Alexander Weygers – Van Nostrand Reinhold (US) 1973 ISBN 0 442 29360 7 – Another good book with sections how to set up a beginners workshop, how steel is tempered and a series of exercises in making tools like hammers, chisels, tinsnips, tool handles and wood carving gouges. A great resource if you want to know more about how tools are made and how you can make your own.

The Recycling, Use and Repair of Tools – Alexander Weygers – Van Nostrand Reinhold (US) 1978 ISBN 0 442 29358 5 – Doing it yourself means you need good hand tools and this book helps you to identify steel to use as a raw material and then make your own chisels, punches, wood and metal lathe tools and bearings as well as showing you how to sharpen edge tools and repair broken garden tools.

While you do still see the above three books for sale separately on occasion, they are also presented for sale as a single volume called The Complete Modern Blacksmith published by Ten Speed Press with an ISBN of 0898158966.

The Practical Handbook of Blacksmithing and Metalworking – Percy W. Blandford – Tab Books Inc. (US) 1981 – Anything I have seen published by Tab seems to be pretty good stuff, and this is no exception. It is 436 pages of good clear information and line drawings covering the forge, anvil and blacksmith tools, iron and steel and basic processes. There are chapters on making various tools, hardware and fittings and over a hundred pages on general metalworking techniques. A very good book!

Practical Blacksmithing – M.T. Richardson (Ed.) – Weathervane Press (US) 1978 ISBN 0 517 25025X – This is a semi-recent reprint of a series of articles written in 1889 – 1891 and I have seen PDF copies of this book free to download on the net. While this book is a mountain of information that moves from the basic stuff about forges and tools to making all manner of strange tools appliances and fittings it is written by blacksmiths for blacksmiths so the beginner may struggle if this were their only reference.

Drakes' Modern Blacksmithing and Horse Shoeing – J.G. Holmstrom – Drake Publishers Inc. (US) 1972 ISBN 87749 020 1 – This is a small, obscure book that covers weird stuff like repairing wagon wheels and axles, fixing plough shares and boiler repairing as well as some basics and horse shoeing. Not for the beginner.

The Blacksmith's Craft – Charles McRaven – Storey Publishing (US) 2005 ISBN 1 58017 593 7 – This is a good start-out book that covers all the basics and some more advanced stuff including forge welding and farriery and even covers making an income from your forge and what prospects and blacksmith has today. This book makes a better use of black and white photos than any of the previous books.

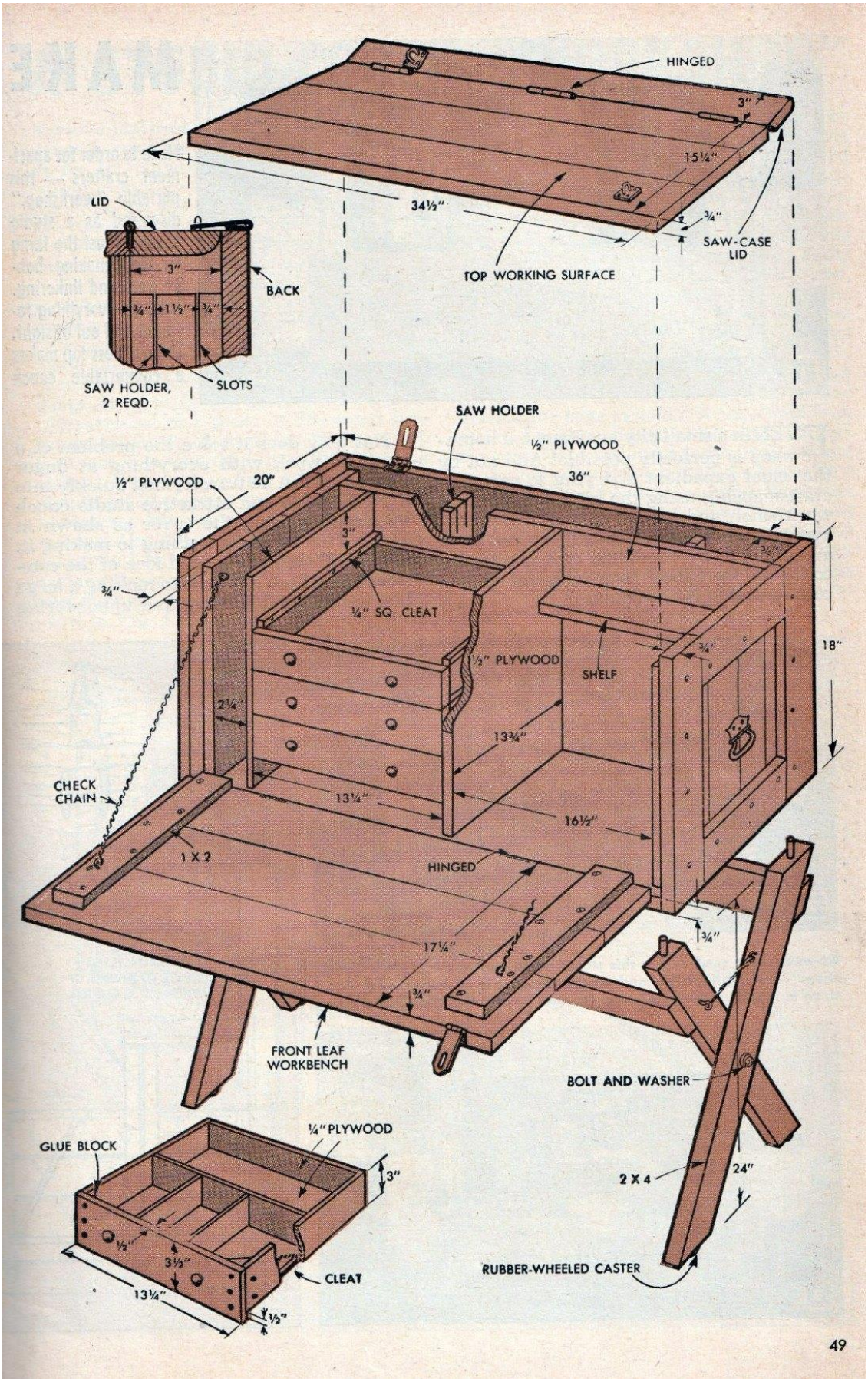
American Blacksmithing – J. G. Holmstrom – Greenwich House (US) 1982 ISBN 0 517 390 485 – This also appears to be a reproduction of an older work, although there is no data about the original publishing. It covers a lot of old stuff including horse shoeing,

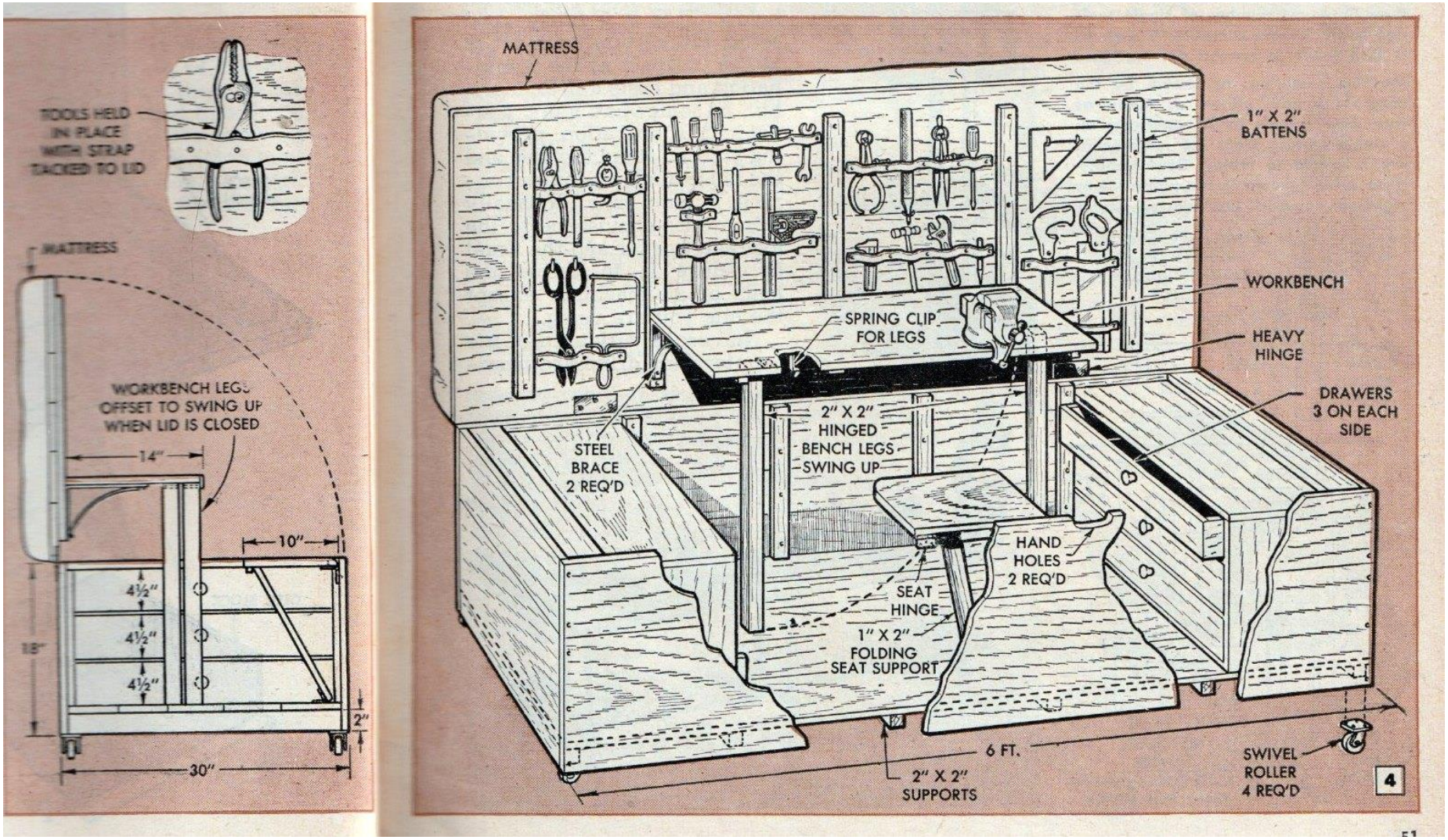
carriage and wagon building and stuff on boilers. There is also quite a bit on tools and toolmaking but generally this is not a book for the novice.

The Art of Blacksmithing – Alex W. Bealer – Castle Books (US) 1995 ISBN 0 7858 0395 5 – While this book has the feel of a reproduction of an older work it appears to be in fact a modern book. The book covers all the basics as well as making tools, hardware, home utensils and other bits and pieces. It also has a section on sword and other weapons and armour making which would be good if you are into medieval re-enactments. Not for the complete novice, but a good book nevertheless.

Make Your Own Woodworking Tools – Mike Burton – Fox Chapel Publishing (US) 2006 ISBN 978 1 56523 306 5 – At last! A book with colour pictures not chatty line drawings! Thi covers some good stuff like making your own forge out of a wok and an anvil out of a heavy lump of steel. It even has a chapter on safety! This is a good book if you want to make or repair your own woodworking tools.

Appendix 1 – Apartment Workshop and Studio Couch Workshop




TOOLS HELD IN PLACE WITH STRAP TACKED TO LID
MATTRESS
WORKBENCH LEGS OFFSET TO SWING UP WHEN LID IS CLOSED
14"
10"
4½"
4½"
4½"
18"
2"
30"
MATTRESS
1" X 2" BATTENS
WORKBENCH
SPRING CLIP FOR LEGS
HEAVY HINGE
DRAWERS 3 ON EACH SIDE
2" X 2" HINGED BENCH LEGS SWING UP
STEEL BRACE 2 REQ'D
HAND HOLES 2 REQ'D
SEAT HINGE
1" X 2" FOLDING SEAT SUPPORT
6 FT.
2" X 2" SUPPORTS
SWIVEL ROLLER 4 REQ'D
4