Hand Planes

The care and making of a misunderstood tool

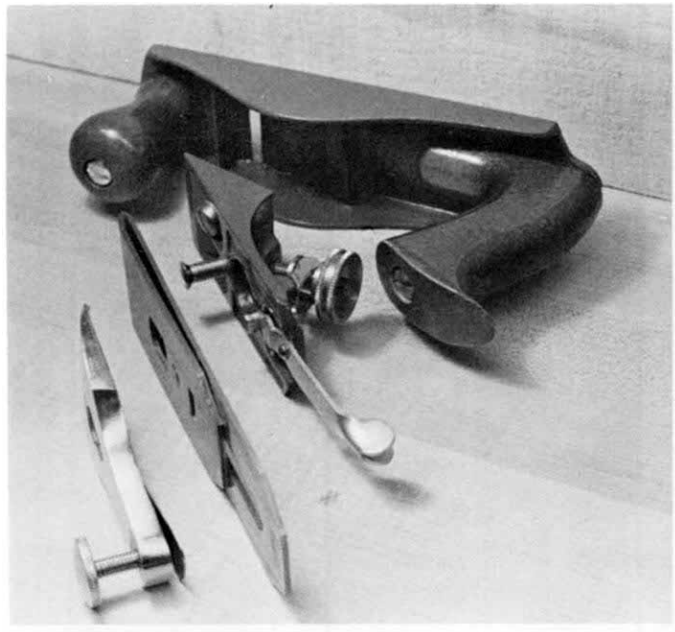
by Timothy E. Ellsworth

A plane is one of the most essential tools used by woodworkers and one of the most misunderstood. A simple examination of most modern planes on the hardware store shelf will be proof of this. The bottom will probably be warped and out of true by as much as 1/16th of an inch. There will be rounded edges around the throat or opening, and the chipbreaker will be very coarsely made.

The result is that a significant amount of remedial work is necessary to make the plane function. If the manufacturers don't understand planes or don't care about these potentially precision instruments, then how can the woodworker be expected to understand?

For those woodworkers who have been frustrated by planes or who have given them up completely, the following discussion might help. I am assuming some degree of familiarity with planes to the reader, but recommend *Planecraft,* published by C.P.J. Hampton, Ltd., Sheffield, England, for fundamental reading, as well as the booklet, *Planes,* published by Stanley Tools.

Let me begin by describing the qualities of a good metal plane, because that is what most people are familiar with. The bottom must be flat, really flat: no warp, no dips or hollows. There must be some provision for varying the opening, either by means of an adjustable throat (used in block planes) or a moveable frog (used in bench planes). The bearing surface for the iron must be flat and free of burrs and irregularities. There must be a cap iron or chipbreaker, except in the case of block planes. Adjusting knobs and lateral adjusting levers are normal on all but the cheapest planes. The steel in the iron must be of high quality, but this is rarely a problem.



A partially disassembled smooth plane. The all-important adjustable frog is between the iron and the plane body. In a block plane, there is no frog; the iron rests on the plane body and a moveable toe plate adjusts the blade opening.

Most of the planes that you will find in hardware stores will have uneven bottoms. There was a time when plane bottoms were precision surface ground, but cost cutting by manufacturers has, for the most part, eliminated this expensive process. The common practice now is to surface plane bottoms on abrasive belts. The result is a less-than-true bottom.

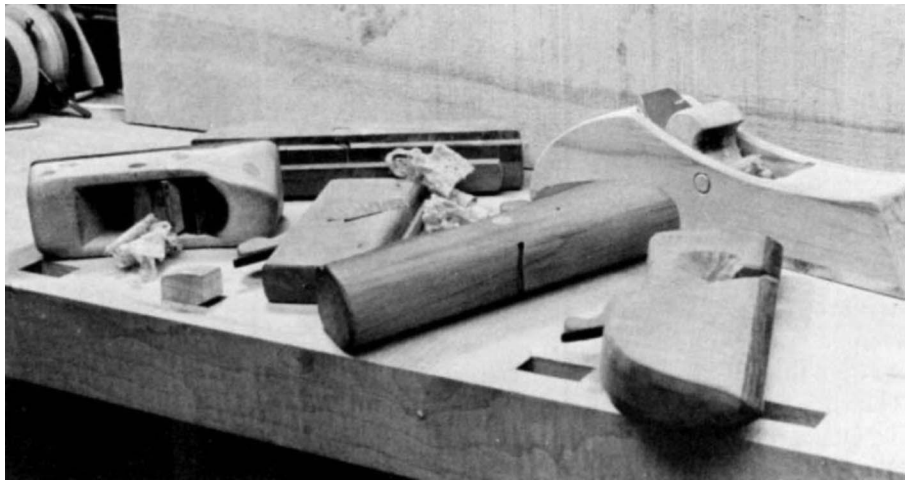
Truing and tuning your metal plane

The surface you are planing can be no truer than the bottom of your plane. You have two options in truing up the bottom. One would be to take the plane to a machine shop and have it surface ground. This might cost about $20 to $30. The second option is to lap it yourself. This process is very simple and requires a perfectly flat piece of 1/8 or 1/4-inch glass at least 12 by 12 inches and some fine abrasive powder such as silicon carbide which can be found at many auto-body shops or art suppliers. Get both 400 grit and 600 grit.

About one-half teaspoon of the 400-grit powder is sprinkled on the glass with about one teaspoon of water. The plane bottom is placed on the glass and a figure eight grinding motion is used, keeping even pressure on the plane all the while. Use the entire surface of the glass to keep the wear even. In a short while the abrasive will become worn out and it will be necessary to rinse the plane and the glass in water and start again.

After repeating the process several times, inspect the bottom of the plane. The dips and hollows will show up as shiny spots not yet touched by the lapping. Continue lapping until they are eliminated and the entire plane bottom is uniformly grey. At the same time the plane bottom is being ground, so is the glass. So try to grind the glass uniformly to avoid making it hollow.

If the glass was flat to begin with and the lapping uniform, your plane should be perfectly flat and true. At this point it is a good idea to lap once or twice more with 600 grit to bring



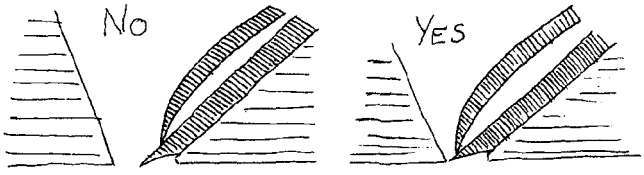
Once you've made your first plane, there's no limit to the different ones you can make. Here's a sample of those made by the author.

up a fine finish. Although it is not necessary, you can polish the bottom with jeweler's tripoli polishing compound. After this step, scrub off the tripoli residue with soap and water. I like to use a touch of parafin to lubricate the bottom as I plane, but this may cause problems later if you plan to use a water stain on the planed surface.

Sometimes the surface of the frog on which the iron rests will be very rough. In this situation lapping can be used to make it flat and help prevent the iron from chattering while planing hard woods.

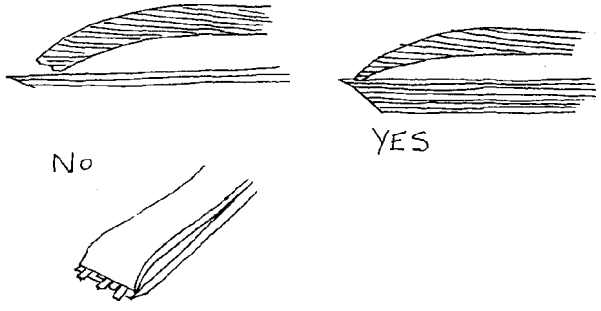
While I am talking about plane bottoms, I might mention the other maintenance which you can do from time to time. Quite often the plane bottom will get nicked, especially on the edges. File or lap off any of the burrs resulting from these nicks. They will show up as lines, even grooves, in planed surfaces.

With the plane bottom now perfect, you will need to set the opening, a most important step usually overlooked. With the iron sharpened, honed and set in the plane, adjust the iron to the maximum depth of cut you expect to make. The



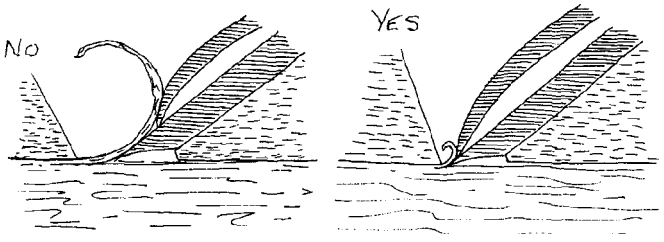
resulting opening in front of the iron should be barely enough to let the shavings through easily. If necessary, remove the iron, loosen the frog screws and adjust the frog. Check the opening again. This opening will be especially critical for very fine cutting in hard woods, curly grain, and for final finish work. Let me repeat that the opening should be as small as possible, but yet let the shavings through easily.

The next concern is the chipbreaker or cap iron. It must be



properly seated on the plane iron. First make sure that the flat side of the iron is just that: flat. There is a tendency when honing the flat side to round it over slightly at the edges. This will cause trouble. Once the iron is flat the chipbreaker should seat on it perfectly when tightened. If you hold it up to the light there should be no light coming through the joint. At the same time the chipbreaker should be sharp right to the point of contact with the iron so that no shavings can get caught or wedged up under it. It will probably be necessary to grind the chipbreaker on your oil stone to make it meet the iron properly.

The chipbreaker should be set back 1/64 to 1/16 inch from the cutting edge of the iron. The closer setting would be used for the very fine shavings on finish work and for hard-to-plane woods. Setting the chipbreaker back 1/32 to 1/16 inch would be for rough work and large shavings. The combined effect of the narrow opening in the plane bottom and the close setting of the chipbreaker causes the shaving to make such a sharp bend that it has no chance of propagating a tear-out ahead of the iron, and leaving a rough surface.



The problems associated with a block plane are not much different than those of bench planes. Because the block plane is used mainly for end grain, the iron is set at a lower angle and is flipped over so that the bevel is up. There is no breaker. The opening is not adjusted by moving the frog, but rather part of the plane bottom at the toe moves backward and forward. The bottom can be ground in the same fashion as the larger planes. One is then concerned only with sharpening the iron, setting the depth, and adjusting the toe plate to close up the opening, as was done for the bench planes.

The uses of planes

To describe the uses of the various planes requires some generalization as there is not much consistency between which planes different craftsmen use for different tasks.

The block plane has two main uses. One is planing end

grain. The other is any planing job requiring one-handed operation. With a low iron angle and the lack of a chipbreaker, the block plane has limited use on long grain because it tends to cause tear-outs.

There is much less consensus on what the specific uses of the various sizes of bench plane should be. There are four common sizes: smooth, jack, fore, and jointer, ranging in size from the smooth (as short as six inches) to the long jointer (24 inches and up). I would venture the following statement: The longer the plane, the less it tends to be affected by local hollows and high points and the easier it is to get a true surface. On the other hand, because of its size and weight, the longer plane tends to be somewhat unwieldy and tiring to use. For larger and longer surfaces it has its advantages. I have seen jointer planes used effectively for everything from six-foot edge joints to three-inch end grain surfaces.

As you might expect, the smaller bench planes such as the smooth plane are much lighter and easier to control, but affected more by the irregularities in the rough wood. Many craftsmen use them, as the name implies, to smooth the marks left by the larger planes. Some might argue that there is really no reason why the larger planes should not leave a smooth surface. In the long run, the individual will find his own preference. The best advice to a potential buyer of a first plane would be to get one of the mid-sized ones, the jack or fore, which are in the 12 to 18-inch range.

A final note on planes and hand tools in general deserves to be made. They are getting harder and harder to find. We have become so dependent on machines that the hand skills are fast disappearing. The manufacturers are responding by dropping many lines. The lines they keep are cheapened since they know that the unskilled public will likely not know the difference. It is sad.

What about wooden planes?

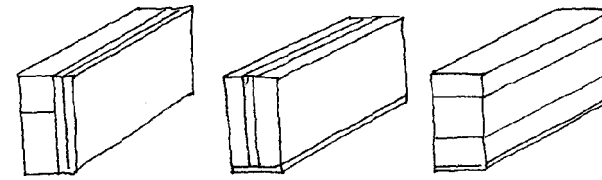
It is fulfilling to make objects of craft or art. To make the tools with which you manufacture the objects is exhilarating. This is the case with wooden planes. They are simply made and can enliven the planing process. As to function, handmade wooden planes can achieve results equal to the finest metal planes—some would say better. They can be made to fit the job: long, short, wide, narrow, curved, flat, or any number of specialized shapes. The plane body can be made to fit your hand and your way of planing. For those who like to work with wood, there is a joy in using a tool also made out of wood.

Are wooden planes better than metal planes? Just about the only factual thing that can be said is that the sole of a wooden plane is less likely to mar the wood being planed. But a wooden plane can't take abuse, so that one's first plane, which does tend to get abused, should probably be of metal. Conversely, a metal plane must be kept tuned to perform right, so that the choice between metal and wood turns out to be mainly subjective.

Materials for making wooden planes

The materials needed to make wooden planes are relatively easy to find. In fact, it is probable that most of what you need can be found in your own shop.

The wood used needs to be a hard, dense wood. We are aiming for a solid blank to make the plane out of, but in most cases this will have to be glued up from whatever is available to you. Hard maple works quite well, as does beech. In fact, many of the old planes were of beech. Oak is hard enough,



but a little too coarse. Other native woods such as apple, pear, dogwood, iron wood and hickory are excellent, if you can find them. The best yet would be to use some of the extremely dense exotic woods to make a thin bottom to glue onto the main body of the plane. Lignum vitae, cocobola, bubinga, and tulipwood are excellent, but as with all good things, they are hard to find and expensive.

You will also need some 1/2 or 3/4-inch dowels, depending on the size plane to be made, as well as some 1/4-inch dowels.

For the plane iron and chipbreaker, there are a number of options. You can borrow one from your metal bench plane or you can find old ones at flea markets, junk dealers and garage sales. You can also get replacement irons for metal planes at some hardware stores or from the manufacturers. In some cases you might find irons without breakers, in which case it is possible, with a little ingenuity, to make the breaker.

I should note here that you may not have access to the machines mentioned in this project. In this event, planemaking will be a challenge, but still quite possible. You may have to adjust the dimensions and use your ingenuity to compensate for the lack of machines. I have made planes entirely with hand tools, but of course it required a lot of patience, bordering on endurance.

Making the plane blank

Measure the width of the iron to be used and add 1-1/2 inches. That will be the width needed for the blank. Much of the extra material will be lost in subsequent machining operations.

Determine how long a plane you want, add at least four inches (more if possible), and that will give you the length of the blank. In no case should the blank be less than ten inches or it will be awkward and dangerous to machine.

For larger planes the blank should be four to five inches high, and for smaller ones, three to four inches. It is best to err in the direction of making the blank too high. (For purposes of this article, dimensions have been standardized. Needless to say, innumerable variations are possible.)

Dimension the blank. In most cases it will have to be fabricated from two or more pieces of solid wood glued together. Once the glue has cured, the bottom should be run over the power jointer to clean up the bottom and to square it to the sides.

If a special hardwood bottom or sole is to be added, do it now. There is no limit to how thick the bottom can be as long as it is over 1/4 inch. Make it oversize in length and width.

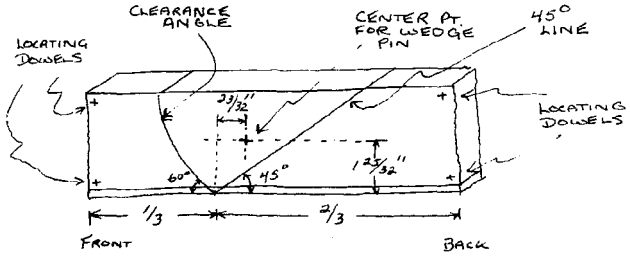
Glue the piece on, let the glue cure, and then plane off the overlapping edges.

With or without the special bottom piece, you should end up with a block that is surfaced and square in all dimensions.

Laying out the blank

Lay the blank on its side and make a mark on the bottom edge where the iron should come through. This should be 1/3 of the distance from the front. Draw a line from this point at 45 degrees toward the rear of the plane. Also mark in a clearance angle. This can be either a straight line at about 60 degrees to the bottom, or a curved line. It should intersect the 45-degree line at the plane bottom.

The center point for the wedge pin must be located, 23/32 inches back of the intersection of the 45-degree line and



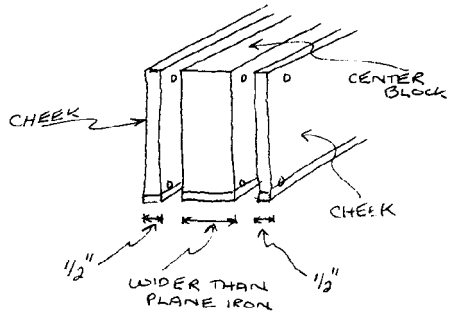
clearance angle, and 1-25/32 inches above the bottom of the blank. Also mark the position of the four locating dowels somewhere near the four corners of the blank.

Machining the blank

With the plane blank still on its side, drill 1/4-inch holes through the blank where the four locating pins go, and a 1*12*-inch hole where the wedge pin goes.

At this point you should have a blank with five holes going all the way through it, and the 45-degree line and clearance angle lines drawn on it. I would transfer these marks onto the top and bottom of the plane so as not to lose them in subsequent operations.

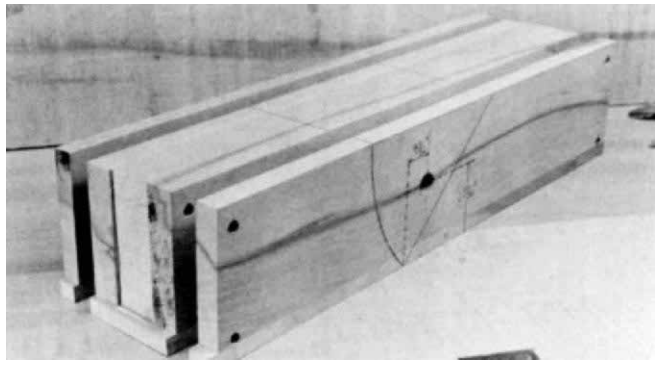
With the plane blank resting on its bottom on the bandsaw table, bandsaw or resaw a 1/2-inch piece off each side. These



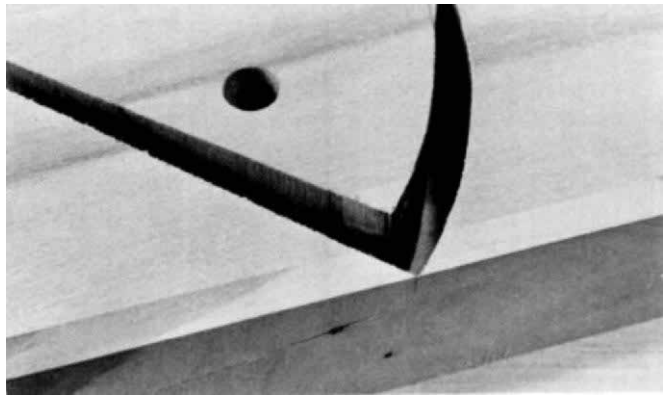
two 1/2-inch pieces are called the cheeks. This operation should leave a center block somewhat wider than your plane iron.

Thickness plane or joint to an even thickness the two cheeks to get out the unevenness left by the bandsaw.

Run one side of the center block over the jointer to get out the bandsaw marks, and thickness plane the other side until the center block is 1/16 inch wider than your iron.



After the plane blank is glued up and the holes are drilled, the two cheeks are bandsawed off.



When bandsawing out the section of the center block, make sure you leave a feather of wood.

From the lines that you transferred onto the top and bottom of the blank, redraw the 45-degree angle line and clearance angle on the center block.

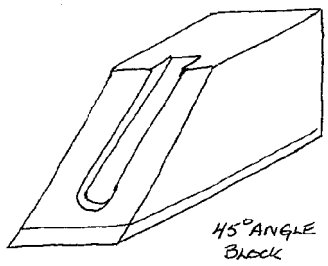
The next operation is to bandsaw out the section of the center block between the 45-degree angle line and the clearance-angle line. This middle piece (with the 1/2-inch hole in it) is the waste piece, and so the bandsawing must be on the waste side of the line. *Do not bandsaw through the bottom.* Rather, have the two bandsaw cuts meet exactly at the junction of the two lines, leaving a feather of wood connecting the two pieces which can be hinged and severed to separate the clearance-angle block from the 45-degree angle block.

If this is done properly, when the two cheeks are put back on and the locating pins put in, the resulting opening should be less than 1/32 inch. Also note not to discard the middle piece with the 1/2-inch hole. This will become the wedge.

At this point you can use any means at your disposal to clean up the surfaces of the 45-degree angle and the clearance angle. I prefer using a disk sander for the 45-degree angle, with the table set carefully at 90 degrees and a mitre gauge set at 45 degrees. To clean up a curved clearance angle, some kind of drum sander is helpful. Be careful to take away a minimum of material to prevent the opening from getting any wider than necessary.

A groove or slot must be made in the face of the 45-degree angle to allow for the cap screw on the chipbreaker. To

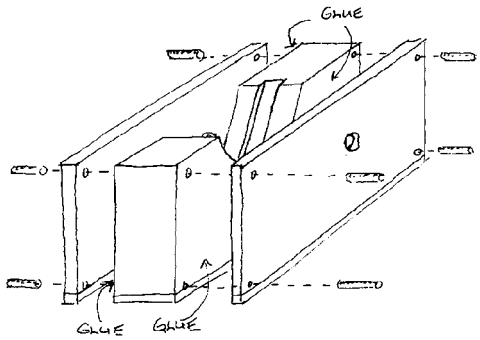
determine how deep and how far down the face toward the opening it must be, you will have to take measurements from your iron and chipbreaker. The slot can be made with a gouge, router, chisel, horizontal boring machine, or any number of other methods you might have at your disposal.



Assembling and adjusting the plane

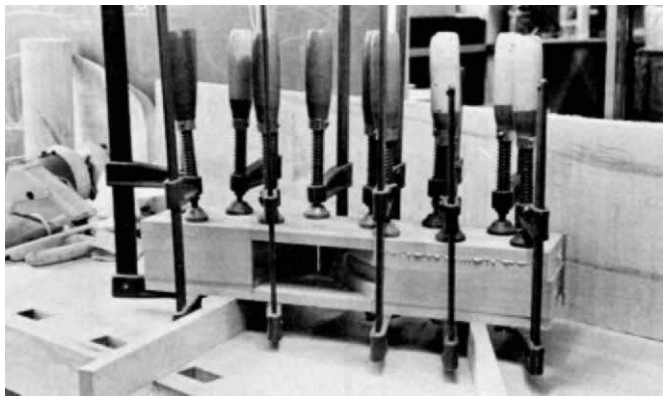
The pieces are now ready to glue back together. Have at the ready eight 1/4-inch locating pins about one inch long with chamfered ends, and plenty of clamps. The objective is to reassemble the plane blank as it was originally, save for the absence of the waste piece cut from the center block.

All in about five minutes time, spread glue on the same side of each of the 45-degree and clearance-angle blocks, position one cheek on, hammer in four of the pins, cut the



pins off flush (this makes clamping and handling easier), turn the assembly over, spread glue on the other side, position the second cheek, hammer in the pins, and cut them off flush; then clamp the whole works with as many clamps as possible, taking care to get tight glue joints on the sole.

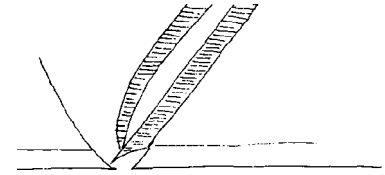
Once the glue has set, unclamp and carefully clean all the excess glue out of the area inside the plane.



After sawing out the center, reglue the cheeks.

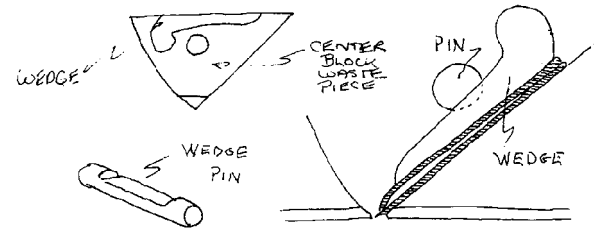
Plane all the locating dowels flush on both cheeks of the plane and lightly joint each side. Hopefully, if all has gone right, you should be able to slip the iron into the plane and it should *not* be able to come through the bottom.

Now, taking very light passes on the jointer, joint the plane bottom to widen the opening. When there is about 1/16 inch left to go before the iron can come through, *stop!* The rest will come off later with a little file.



Sand the bottom carefully by placing a full sheet of fine sandpaper on a flat surface and rubbing the plane back and forth on it.

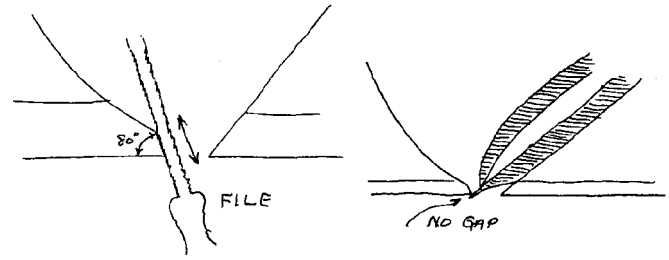
Before fitting the iron further, make a wedge out of the waste piece cut from the center block. It should not be so long that it blocks the shavings. It must also be narrow enough not



to be too snug against the cheeks. Cut a length of 1/2-inch dowel for a wedge pin, making it as long as your plane is wide. File a flat on it wide enough to accommodate the wedge. Insert the pin with the flat down, but don't glue it.

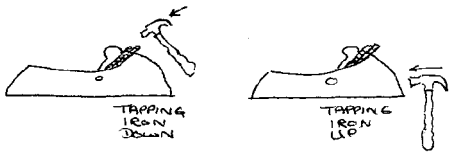
Adjusting the opening

The adjustment of the opening is the most critical step in the making of a plane. The thing to remember is that you want the smallest opening that will still allow the shavings to pass freely. Using a small, fine needle file, file the leading edge of the opening at about 80 degrees to the bottom until the iron just slips through with no clearance to spare. Be



careful, all the while, that the opening is even all the way across. At this point, a little bit more filing will begin to give the clearance needed to allow the shavings through. At this stage it's a good idea to seat the sharpened iron, chipbreaker and wedge, set the depth on the iron, and try a shaving or two.

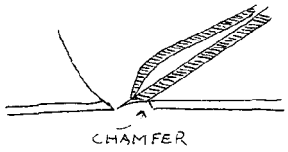
(Adjust the iron down by light hammer taps on the back end. Adjust the tilt by tapping the sides of the iron. Bring the



iron and wedge out by tapping the rear of the plane. The wedge should be tapped snug after adjusting the iron.)

If the shavings jam up in the opening, then it needs to be wider. Take the iron out, file a little more, and try again. You may have to do this half a dozen times.

When you finally get it right, take the iron out and chamfer the trailing edge of the opening. This will prevent it from getting chewed up. It does not affect the plane's function.



At this point you are on your own to modify and shape the plane to your own special design and use to fit your own hands and function. The only points to consider are that the rear of the iron should project slightly to allow easy tapping. (Most of the time I shorten the length of the iron so it does not project up too far.) And some provision should be made for tapping the iron and wedge up to remove them. A flat on the rear of the plane or a turned button there work well.

Remedying mistakes and defects

There are many little problems and mistakes that can be made but overcome.

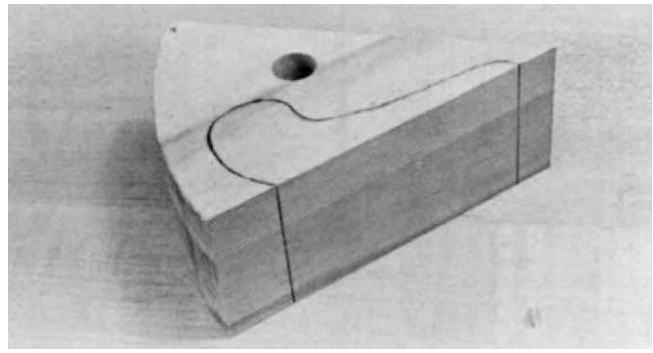
If the opening is too wide, make a new sole and add it on. Or cut out a section of the sole in front of the opening and replace it with a larger piece to close up the opening. Or move the 45-degree angle block forward before the glue up. Or use a thicker iron.

If the iron is too wide for the plane, grind it narrower.

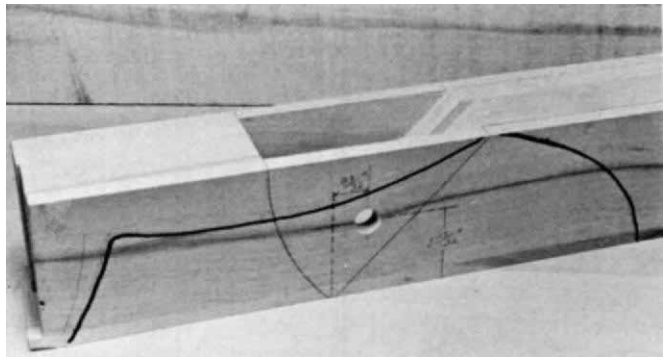
If the wedge or iron keeps slipping back, reduce the angle on the wedge, or roughen up the surface of the 45-degree angle block.

If the iron chatters when cutting, make the bottom side of the wedge concave to put more pressure down low on the iron.

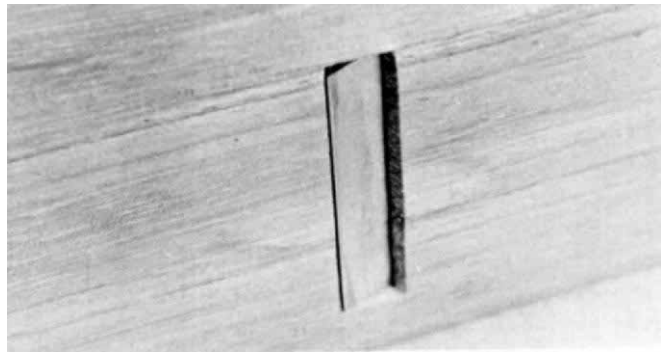
In the interest of space, I have not mentioned many of the options and alternatives available. But in demonstrating the process to students, I have seen so many different ideas, shapes, and methods of construction, and the like tried—most of which work beautifully—that I am convinced that the sky is the limit on how these planes can be made. Any number of different planes can be made with modifications of the techniques described: molding, flat, round bottom, compass, block, bullnose, rabbeting, to mention just a few. But that is a whole subject in itself.



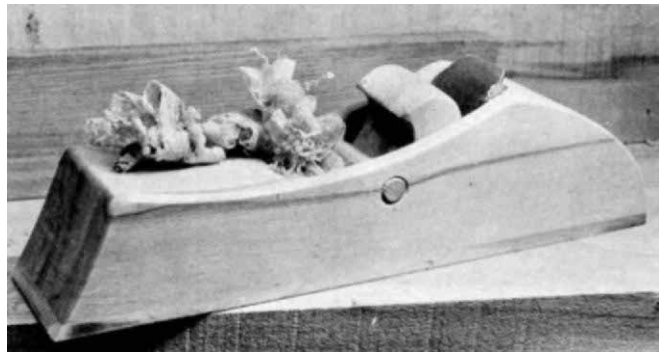
The section cut out of the center is a handy piece to use for the wedge. The precise shape is up to you.



The plane is now ready for the critical adjustment of the opening using a jointer and needle file.



This is how the opening should look after it has been correctly filed. Chamfered trailing edge is not critical.



The finished plane, test shavings and all. Make the upper body shape whatever is most comfortable for you.