

# THE PLANE TRUTH

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## Acknowledgements

Although the ideas presented in this booklet are those of one man, Robert Meadow, the authorship is shared with his wife, Bonnie Robiczek. Robert's many years of experience and observation have brought penetrating insights into the use and conditioning of tools. Bonnie is able to organize this information and to present it in what we hope is a readable form. Together we present this booklet in hope that it will satisfy a need in the world of woodworking.

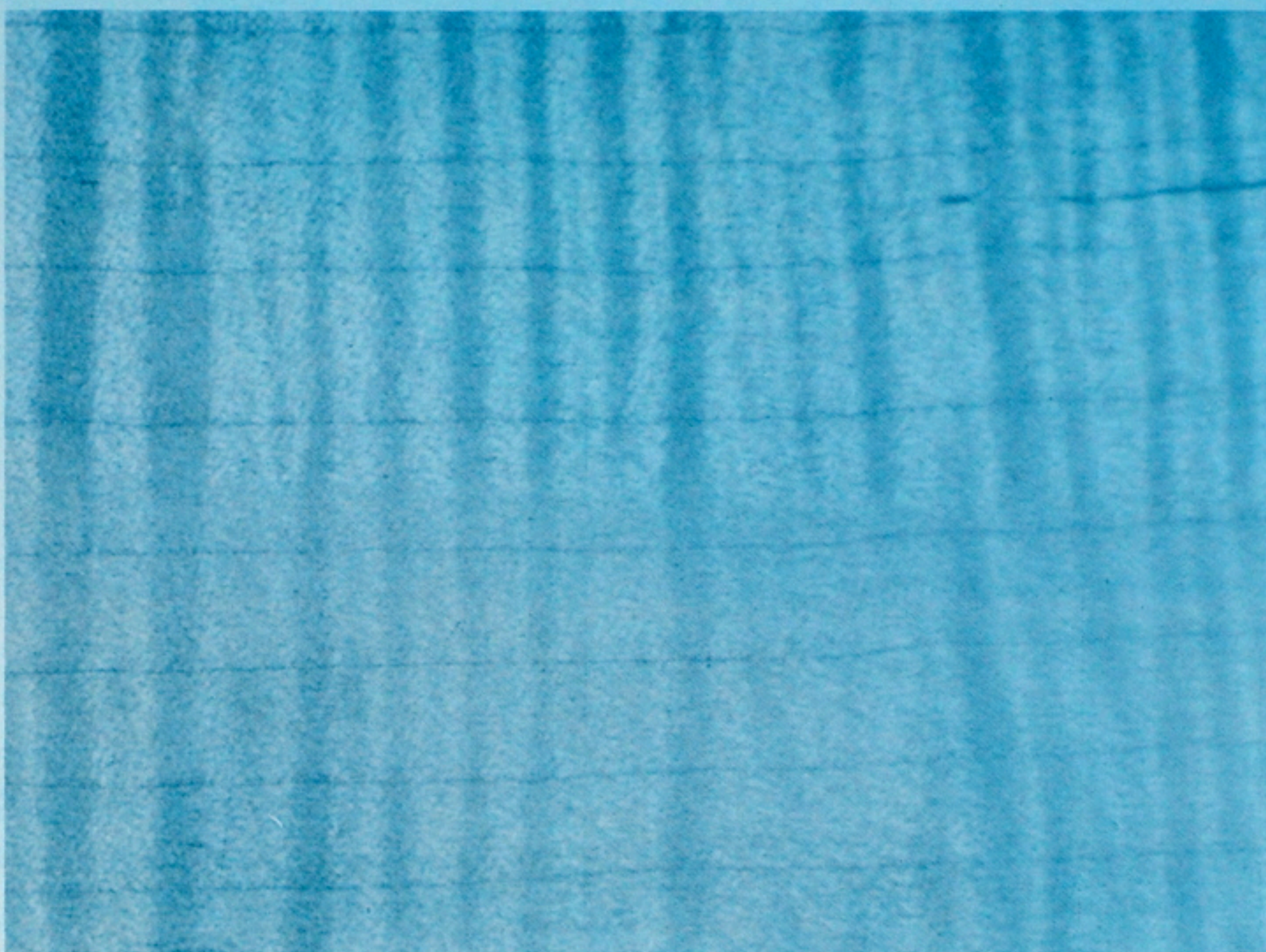
We would also like to express our gratitude and respect to Thomas Reese Williams, who took the photographs, to George Young who made the drawings, and to Hidenori Kamata for the calligraphy design.



# THE PLANE TRUTH

A Japanese finish plane can leave a mirror surface on even the hardest, most figured woods. The results are better than anything you can do with sandpaper, and when everything is just right, finish planing can be both efficient and exhilarating. Getting "everything just right," means being aware of the implications of each stage of the set-up, from shaping and sharpening the blade, to fitting the blade to the body and shaping the sole.

If you're new to Japanese planes the basics are simple. To remove the blade and sub-blade, place your thumb on them to keep them from popping out unexpectedly while you tap on the chamfer at the back of the body with a hammer. This is called backing out the blade. When you hammer a blade in, you can hit a little more on either side of center to get it in centered. As you tap the blade in, watch it come up through the throat opening from the back. When it's close, then turn the plane and watch the blade rise above the surface of the wood. If you rotate the plane downward toward your light source, the wood will reflect the light, so that the blade looks black against it. This contrast makes it



*The difference in results from sanding (bottom) and planing (top) are clear to see.*

easy to see the smallest setting. Natural light or a single incandescent light lamp are better than florescent lights when you use light in this way.

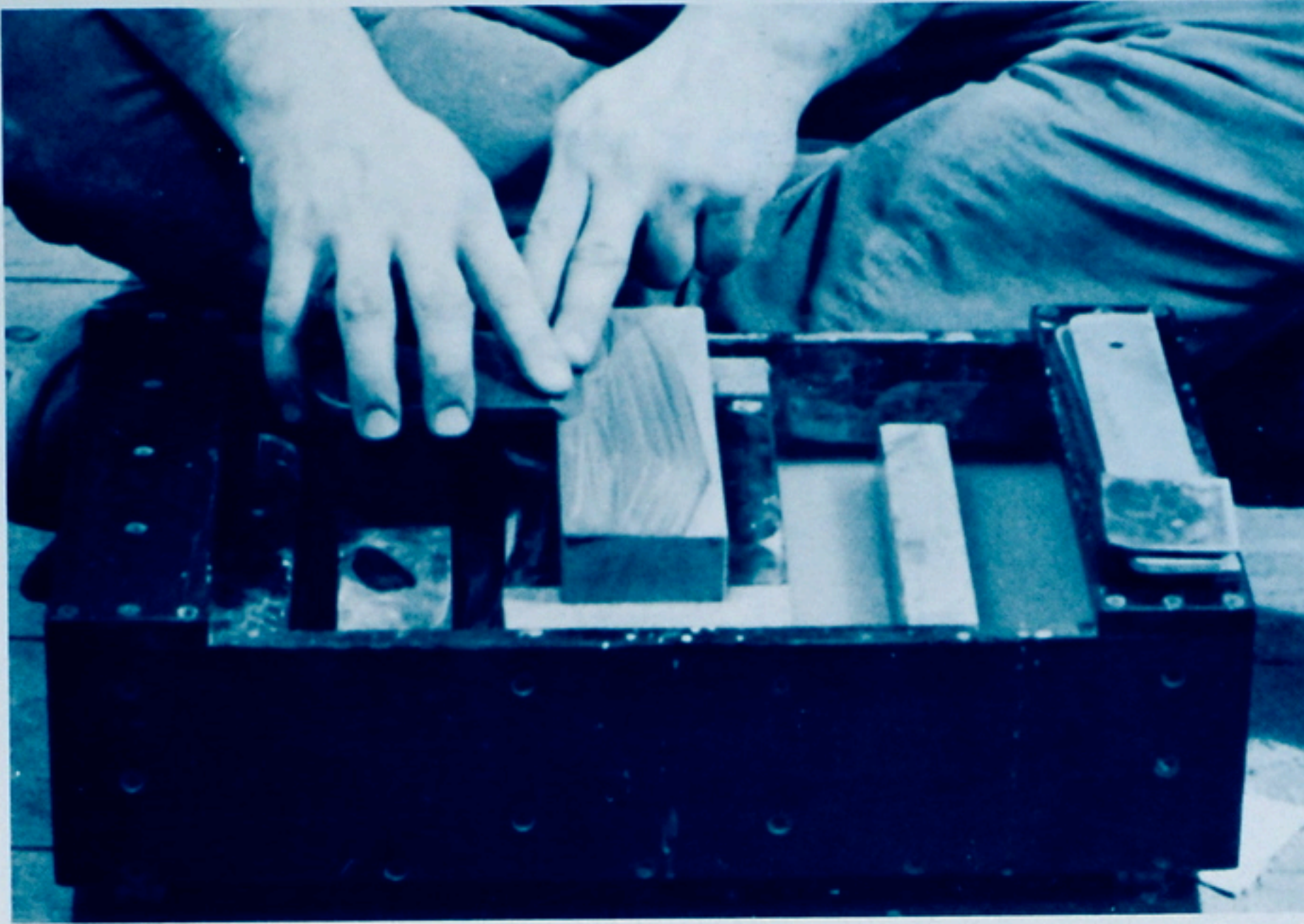
## **Sharpening: Shaping the main blade**

Sharpening can be broken down into shaping, eliminating scratches, removing the burr, and polishing the edge. Water stones can be divided into coarse, middle and finish stones, which correspond to the stages in

sharpening. For shaping, I use a 1200 grit Aquastone.

Backing off, the first step in conditioning any tool, means flattening the blade on the hollowed face. However, this surface is not entirely flat. The land along the edge should be perfectly straight, but the two lands perpendicular to the edge are slightly concave, about 1/64". This curve serves the purpose of allowing an elastic fit into the plane body, and also helps you to get all the way up to the edge when it comes to the final polishing stage in sharpening. For this reason, don't put the whole blade down flat on the stone when backing





*The position of the hands and the blade for backing off.*

off, which would remove the curve. Begin at the edge, supporting the weight of the rest of the blade. Use the fingers of your right hand for stops and work moving in and out. Where you exert pressure with the fingers of your left hand will effect where you are cutting the steel. Look for even blackness on the stone which means steel is being cut. The goal is to even out the land along

both sides and along the edge. Better planes will require less work to accomplish this task.

To inspect the blade, turn it in the light. When the land looks white, you are seeing the light source reflected back to you. Using the light this way you can see any imperfections and deviations from flat. These deviations will reflect the light differently than the

smooth areas, and so become visible. At this point in the sharpening process, you will see that the scratches are not all lined up. You are also likely to see a falling off from flat, usually on the left side of the land along the edge. This tells you that the blade needs to be tapped out to restore the land in this area.

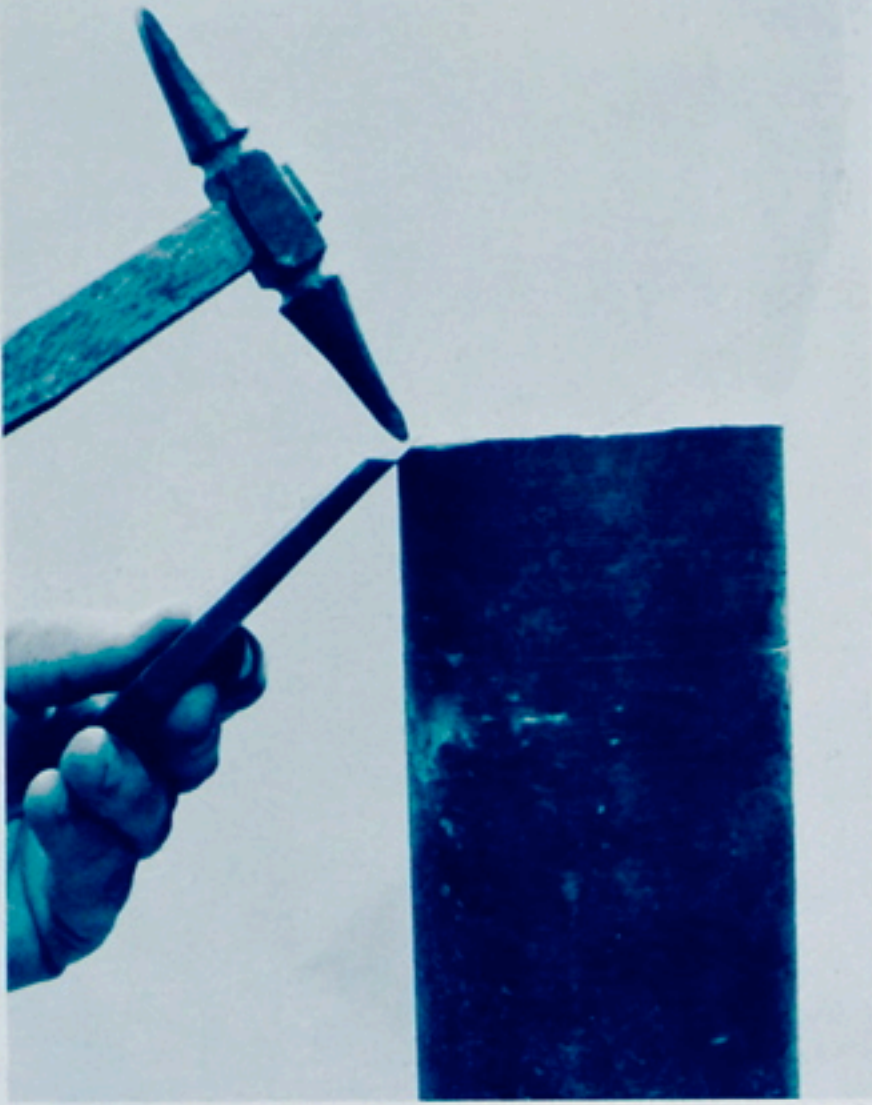
## Tapping out

Tapping out is one of the cold-working processes that tensions the blade. Tensioning spring-loads the blade against the downward pull of the wood when you take a shaving. To tap out the blade, I use a cross-peen hammer 3/16" to 3/8" by 1/16" to tap gently on the bevel side of the blade. You need support directly opposite where you hit, for example a rounded spot on an anvil. (See photo on page 3). I always position the hammer over



*Left: An ideal example of even lands on the hollow side of the blade. Center: Too much pressure was exerted in one spot, causing this land to have a groove that will have to be worked out later. Right: This blade was blackened before the hollow side was backed off. The blackening allows you to see the area that is not making contact with the stone, indicating that the blade needs to be tapped out.*

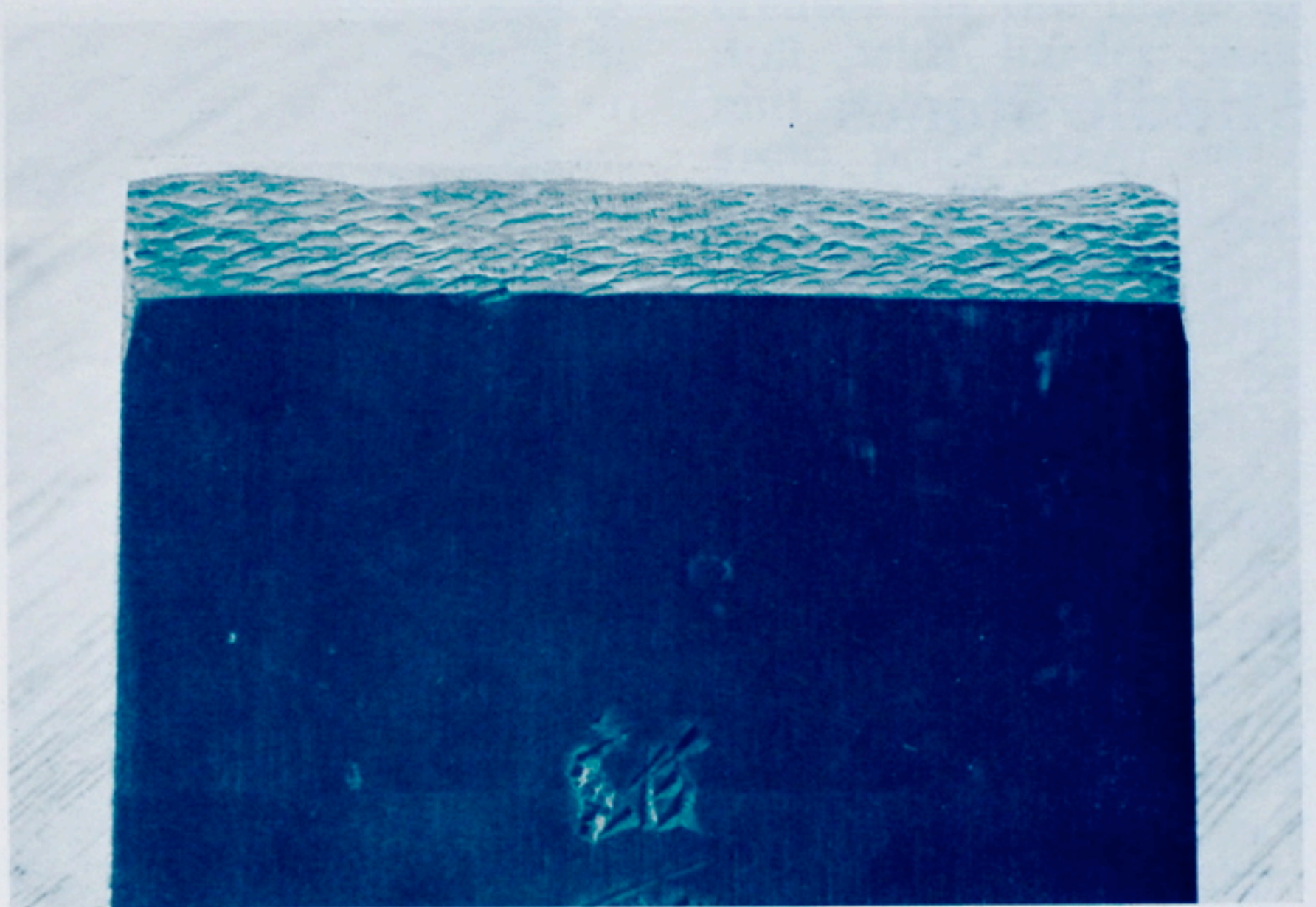




*Left: The proper position of the hammer, blade and anvil for tapping out a blade. Below: The marks left on the bevel side of the blade after tapping out. Bottom: Robert Meadow tapping out a blade at his sharpening station. Note that the hammer is held low down on the handle for maximum control. With the grinding wheel, stone container and anvil conveniently located in one area, one does not have the tendency to skip important steps in the sharpening process.*

my point of support first, and then position the blade. Try a few taps as you rotate the blade in its position, until you stop hearing a clanky sound. This is what I call the 'sweet spot' where the taps will be most efficient. When you have the angle right, start tapping at the heel of the bevel and progress toward the toe moving the blade back and forth like a typewriter. Advance only as far as the weld line between the mild steel or wrought iron and the tool steel. When this is done, you can go back to the coarse stone to flatten the land that has been restored on the hollowed side.

The bevel should be perfectly flat perpendicular to the edge. This will give you a keen, stiff edge. However, along the edge of the blade, a curve must be shaped, that is equal to the thickness of the shaving you desire. This is done by control-



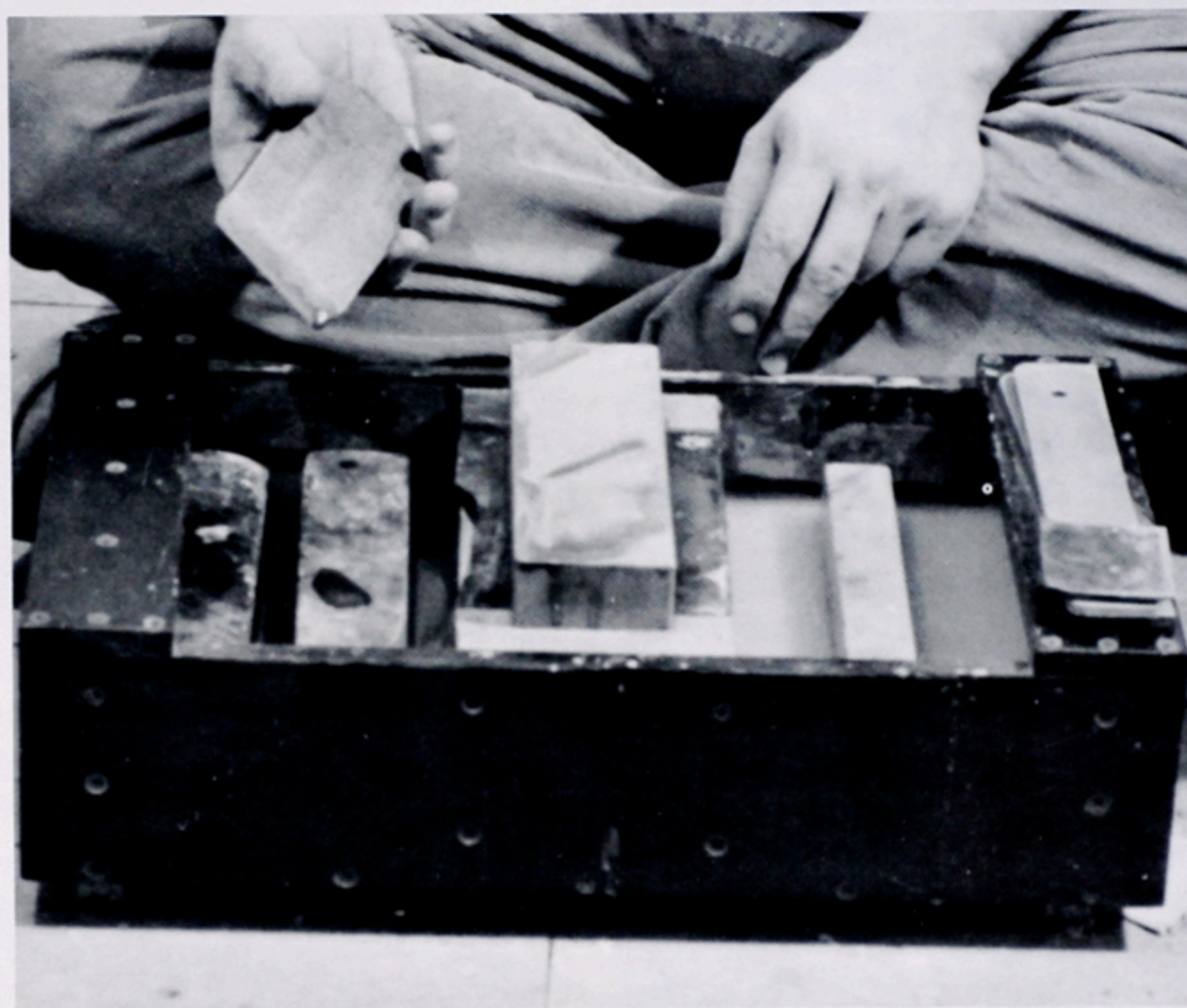


ling the pressure with the fingers of the left hand. If the edge were perfectly straight, the corners would dig into the work because the body of the plane distorts the blade. I use a dark plastic straight edge, 2 1/2" x 1/4" to check the curve of the edge. The plastic doesn't distort from moisture as a wooden tool would.

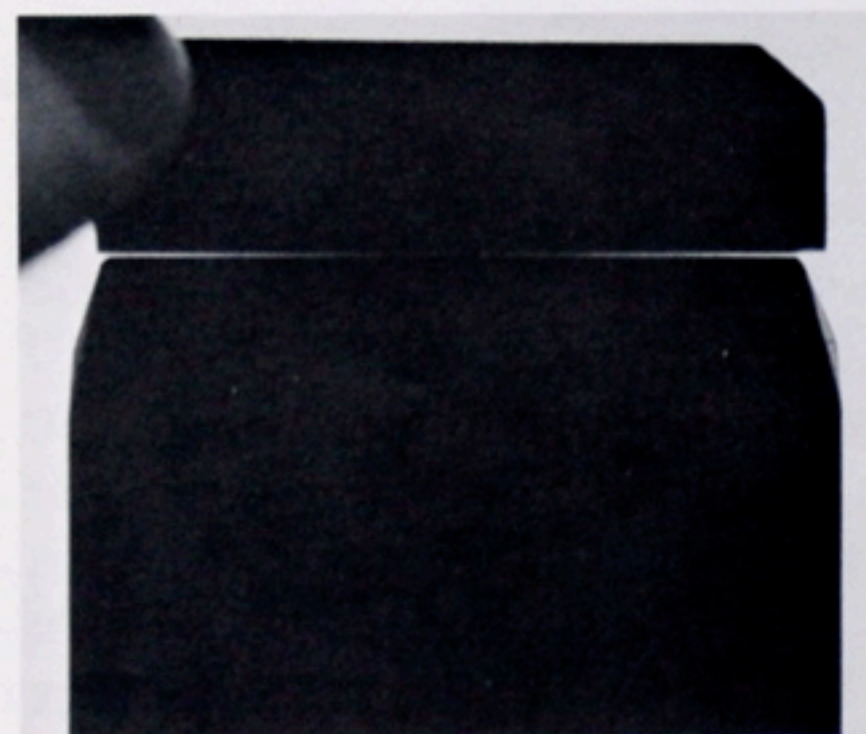
## Middle Stones

Once you have the right shape you can begin eliminating the scratches left by the coarse stone, using middle stones. I use a very flat, hard stone (the Binsui and Tajima stones are both good) with the mud from the 1200 stone or an Akamonzen stone to remove the scratches left from shaping. However, the hard stones, while retaining the shape you've created, can work-harden the steel. That's why I use a softer natural middle stone next, an Aoto. This stone won't get out the deep scratches the way the harder stones do, but it is more elastic so it removes steel without work-hardening. By ending with this stone before going to the finish stone you expose new steel, which hasn't been work-hardened.

Many woodworkers don't pay much attention to just how they remove the burr; in my experience, the way



*Top: Position for sharpening the bevel side of the blade; Center: Here the position of the fingers in holding the blade is shown. Right: Checking the curve of the blade with the plastic straight edge. The light showing between the blade and the straight edge indicates the amount of curve in the blade.*







*Bottom: Chipped blue steel blade; Center: dull blade; Top: sharp blade.*

this is done will affect how long the edge stays sharp. As you get the blade keen, you create a burr. You can feel the burr with your finger, bending over toward one side, or sticking straight out from the edge. Gently cut it off using the hard middle stone with the mud of the Akamonzen. If you keep bending the burr back and forth, you work-harden the metal. This may cause the burr to break off suddenly; the metal left at such an edge is fractured and will chip easily.

## Final Polish

After removing the burr, the edge should be polished on a finish stone. Be sure that the finish stone is not dry, as this will also work-harden the steel. The best finish stone is a Honyama. It gives the highest polish, and cuts quickly, which reduces work-hardening. The hardness of the Honyama produces a keen edge. Since these are expensive stones, you may want to work first on a Suita stone and then the Honyama, so the Honyama will not be used up too quickly.

Again, you can use the white light to help you look for any imperfections. Watch the white light move around the land on the hollowed side as you rotate the blade towards you. Suddenly the white light disappears, goes blue-grey. Now you will see the reflected light on the edge itself if it is at all dull, rounded over, or nicked. Rock the blade slightly side to side to play the light along the edge to see the imperfections. The light is amplifying what is there. When the light no longer reflects off of the edge, the blade is truly keen.

## Sub-blade

The sub-blade is sometimes called a chip-breaker, but I feel this is a misnomer. It doesn't break the chip, but stiffens the blade. The blade will tend to be pulled down into the wood as you take a shaving. This force increases as the blade gets dull, with harder woods, and as the direction of the grain pulls down on the blade. The sub-blade counteracts this force. It also tilts the shaving. Planing without a sub-blade, leaves a shinier surface on the wood because the shaving travels straighter as it comes up through the throat opening. If you are planing hardwood, however, using a sub-blade may be unavoidable.

The sub-blade is conditioned much like the main blade. First back off the hollow side, leaving a slight curve perpendicular to the edge. Next, tap it out. The bevel side is treated differently. The edge is not curved as on the main blade, but straight, following the chord of the blade's arc. If it were curved, it would be so close to the blade the shavings would jam.



The bevel itself doesn't need to be flattened, but a micro-bevel is put on the bevel side by holding the blade up at an angle of  $55^\circ$  -  $60^\circ$ . The size of the micro-bevel ranges from  $1/32$ " for softwoods to  $3/32$ " for hardwoods. The micro-bevel should be very straight and polished and the edge keen.

## Fitting the blade to the body

Now you are ready to fit the blade to the body. The body will have shrunk since it was made in Japan. The blade will be too tight side to side, and too tight in back. As the body dries, the annual rings try to straighten out so the body pushes up in the middle. Remove the pin that goes across the blade and sub-blade, as well as the blades themselves. The first step is to mark out the width of the main blade centered on the top of the body, using a pencil. Both cheeks should be the same width. Mark out the width just a little wider than blade, about  $1/32$ " on each side of the blade. This is to leave room for lateral adjustment. On the bottom side of the plane, the width of the blade is marked at the mouth, centered. This should be a snug fit, so mark exactly here. Next mark out the sub-blade with the same tolerances as the main

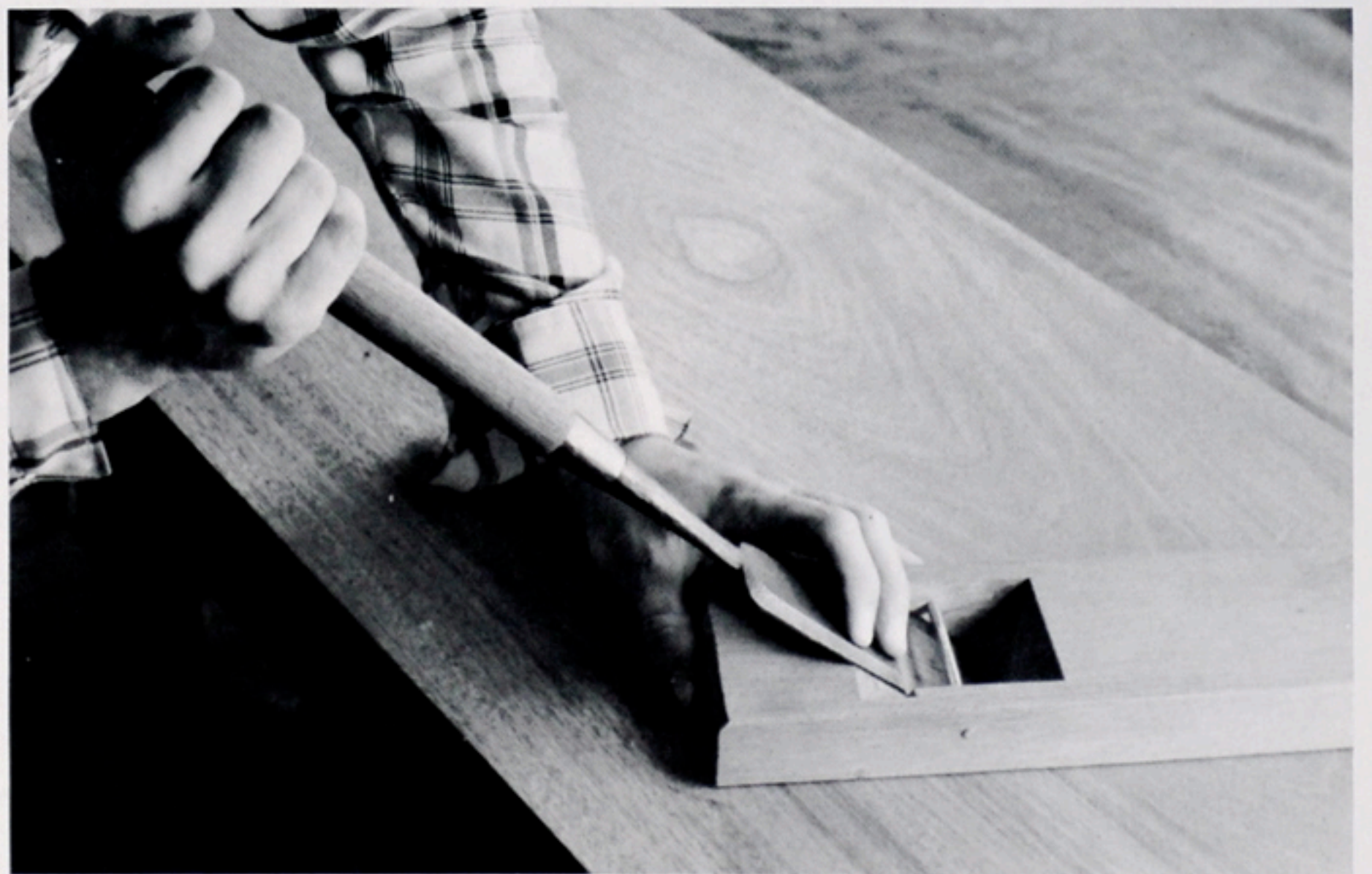
blade. The width of the sub-blade determines the width of the throat opening.

Using a  $1/16$ " or  $1/8$ " chisel, make straight and flat surfaces between the marks for the main blade. Be sure to get all the chips out of the corners so nothing throws the fit off.

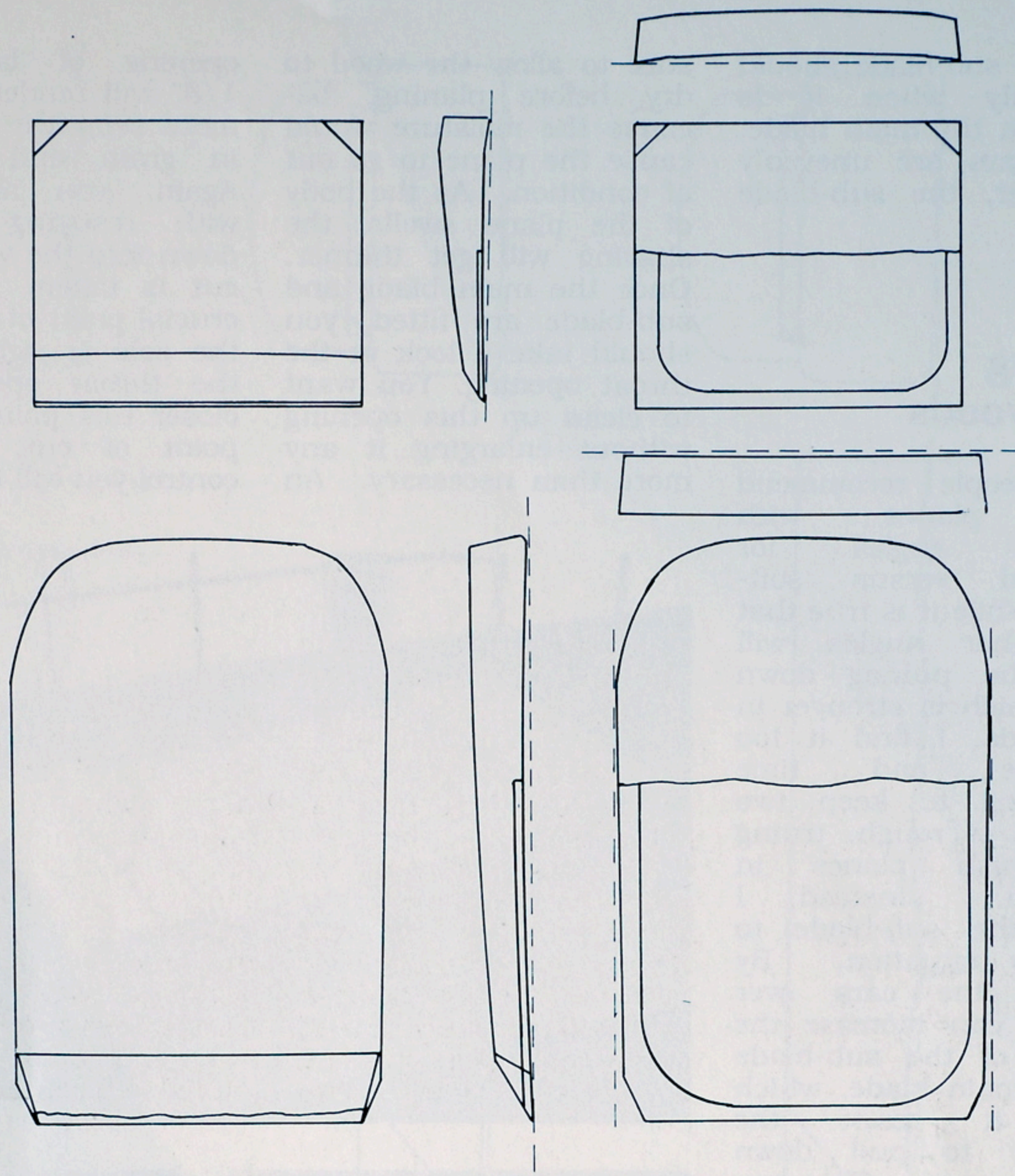
The sides of the blade should fit so that there is enough room for lateral adjustment at the top, and just barely fit at the bottom. How tight you fit the sides and back should also reflect the climate you are fitting it in, the climate it will be used in and the season of the year. Fit it looser if you are setting up the plane in the summer, tighter in the winter. Generally, leave the fit a little tight at first, as it will probably loosen up as time goes on. You can always open it up more later. If the blade mushrooms at the back

when you tap it into the body, the fit is too tight.

The blade is centered and held in place by the way the back of the blade is fit to the body. The back of the blade is curved, as is the surface it rests on. The alignment of these curves determines the fit: centered, off-center or askew. The blade will be pulled towards the area that is too tight. You can determine where wood needs to be removed by observing whether the whole length of the blade is pulled to one side or if the blade is askew. Another help is to cover the back of the blade with pencil and tap in the blade until the tap tone stops rising. When you remove the blade, marks will be left which give you an indication of where the blade is making contact. Your observations of which way the blade is being pulled off center will help you determine which of these pencil marks to







pare off. You may have to repeat the process of penciling, tapping in and paring a few times until you find all the places the blade gets hung up. It's good to remember that if you fit the blade tight in the body the curve of the blade will be straightened out just a bit. Also, when you set the plane down on the bench, do it gently. If you set it on its side heavily, you can knock the

blade out of center, causing the blade to dig in on the side the next time you take a cut.

### Fitting the sub-blade

The upper corners of the sub-blade are bent down to tension the sub-blade

and exert pressure at the edge down onto the main blade. These ears, as they are called, should be hammered over following the same principles of support as in tapping out. If you are getting a thicker shaving planing against the grain than with the grain, the tension of the sub-blade needs to be increased. A sub-blade that is too loose can cause the plane to dig in or tear



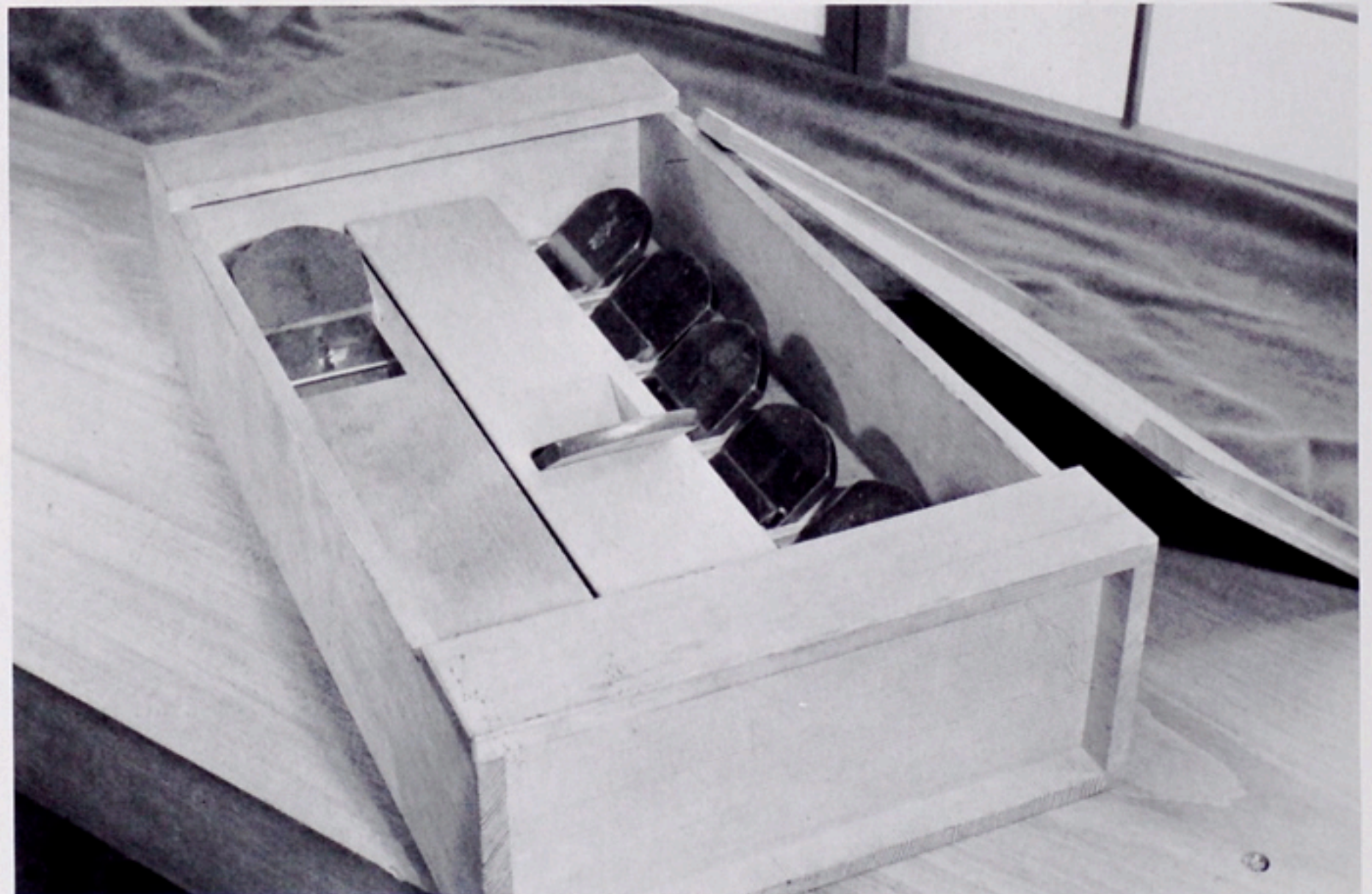
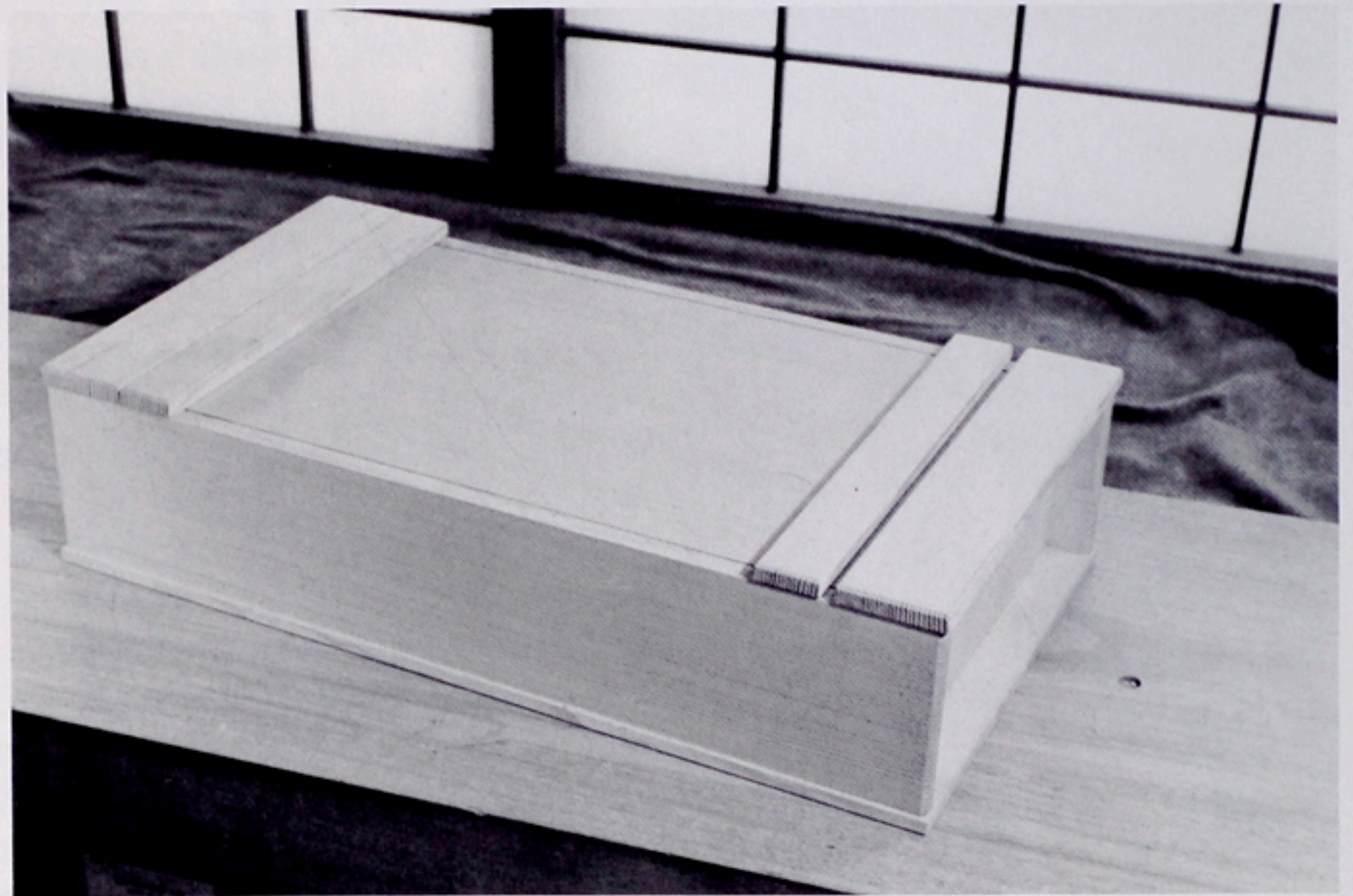
out. The sub-blade should sit firmly when it is placed on the main blade. If the ears are unevenly bent over, the sub-blade will rock.

## Planing Hardwoods

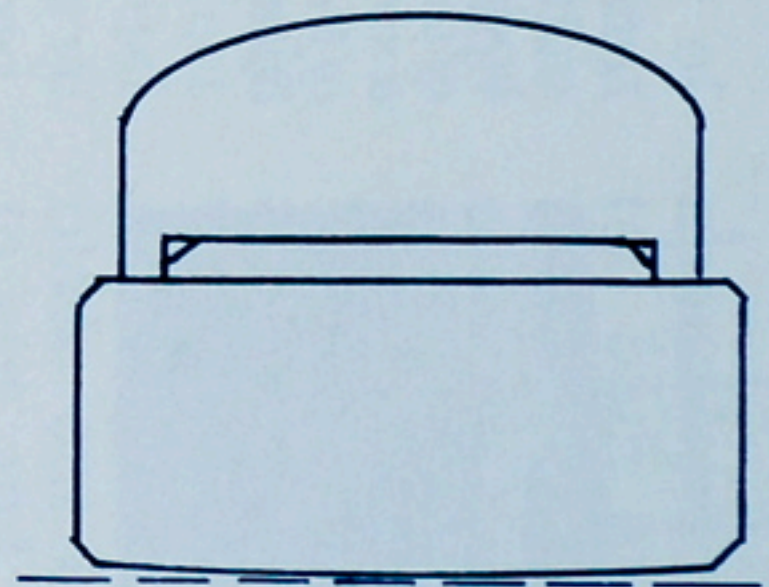
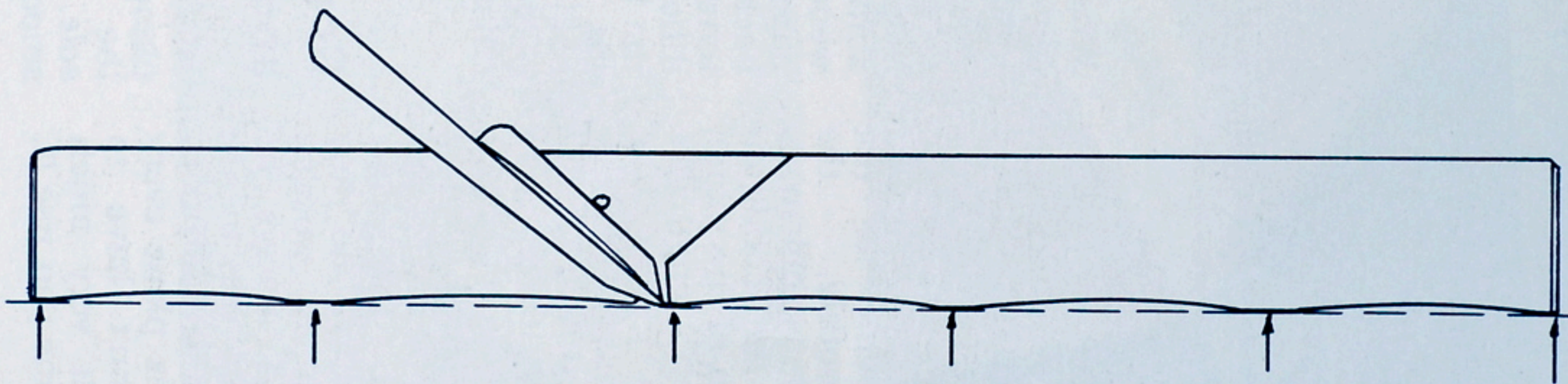
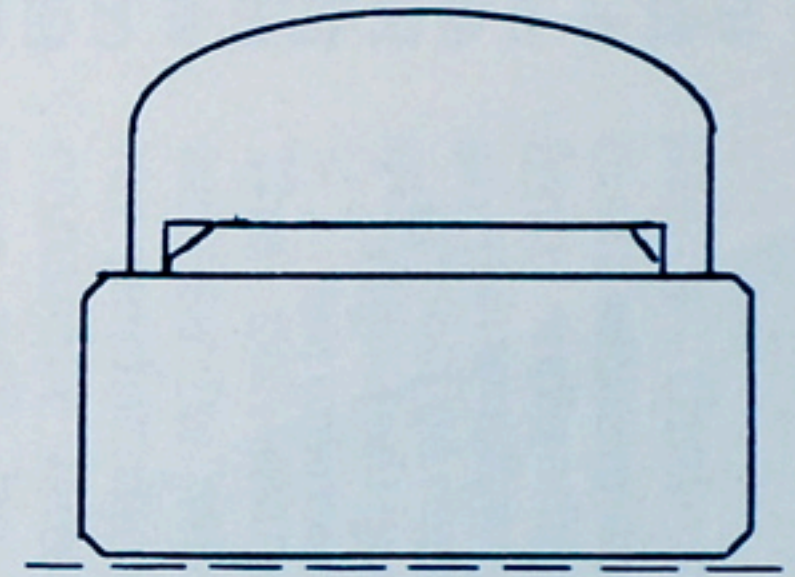
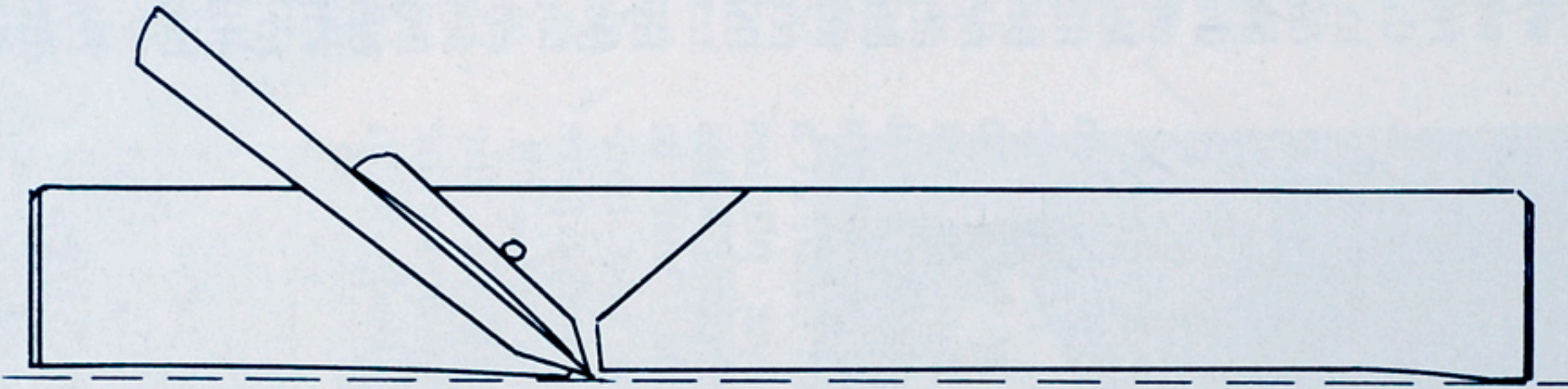
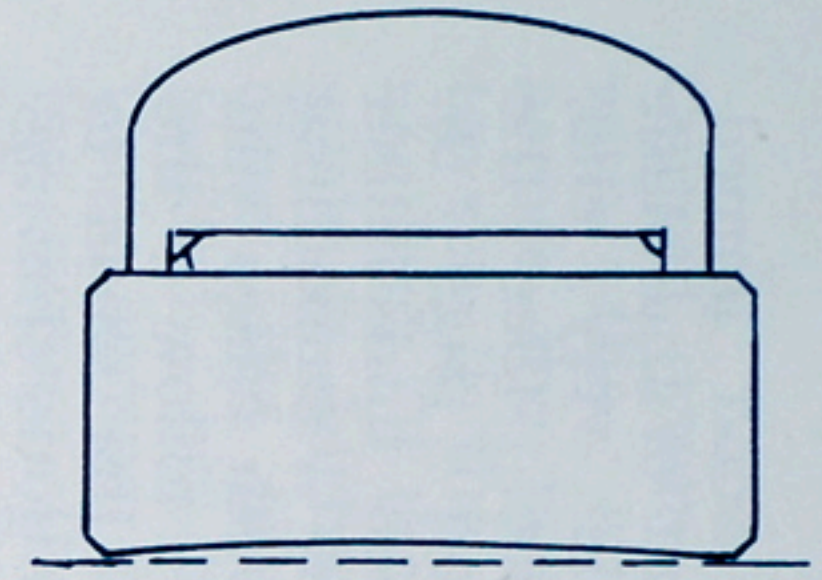
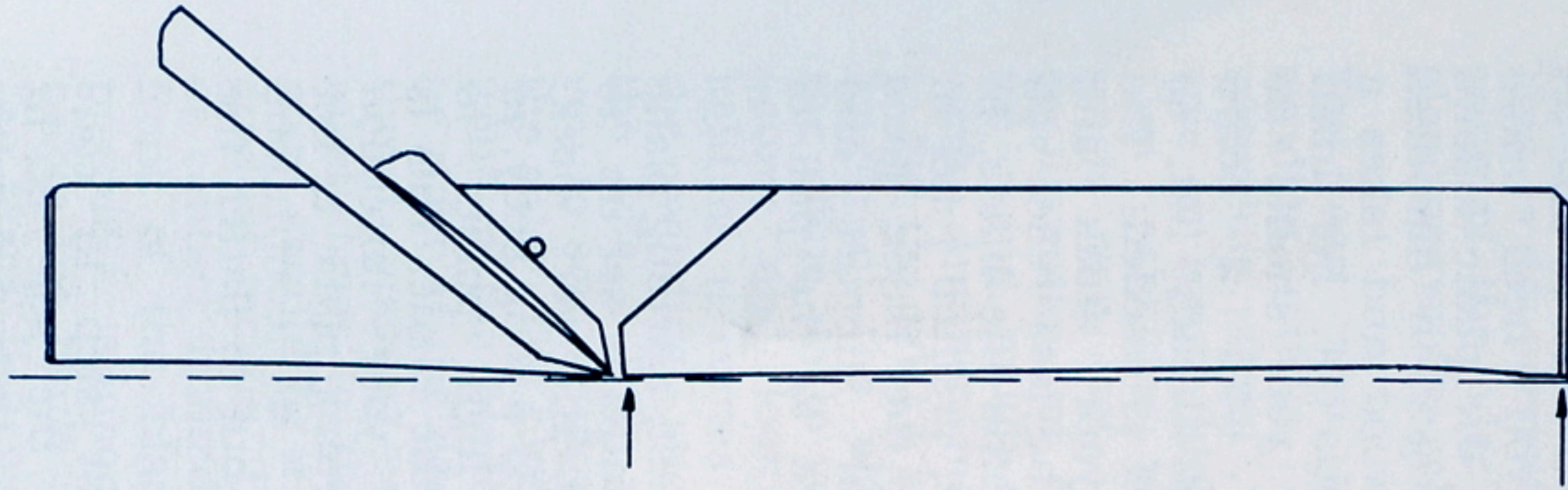
Some people recommend using planes with different angles for hardwood versus softwood. While it is true that the higher angles will resist the pulling down effect which is stronger in hardwoods, I find it too expensive and time consuming to keep two full sets of rough, truing and finish planes in condition. Instead, I adjust the sub-blade to suit my situation. By bending the ears over more, I can increase the tension of the sub-blade on the main blade, which helps it resist the tendency to pull down into the wood. This can also have the effect of deforming the edge of the sub-blade unless it has been tapped out to help increase the tension at the edge. The wider micro-bevel used for hardwoods serves to accommodate this increase in tension. Here's another little trick. When planing difficult grain or end grain, I wipe on a solution of glycerine and water (1:16); this softens the wood and makes it less resistant. You must be

sure to allow the wood to dry before planing, because the moisture would cause the plane to go out of condition. As the body of the plane swells, the shaving will get thinner. Once the main blade and sub-blade are fitted, you should take a look at the throat opening. You want to clean up this opening without enlarging it any more than necessary. An

opening of larger than 1/8" will render the plane more sensitive to changes in grain and hardness. Again, you are dealing with resisting the pull down into the wood as the cut is taken. The most crucial point of support on the sole is right there at the throat opening. The closer this point is to the point of cut, the more control you will have.





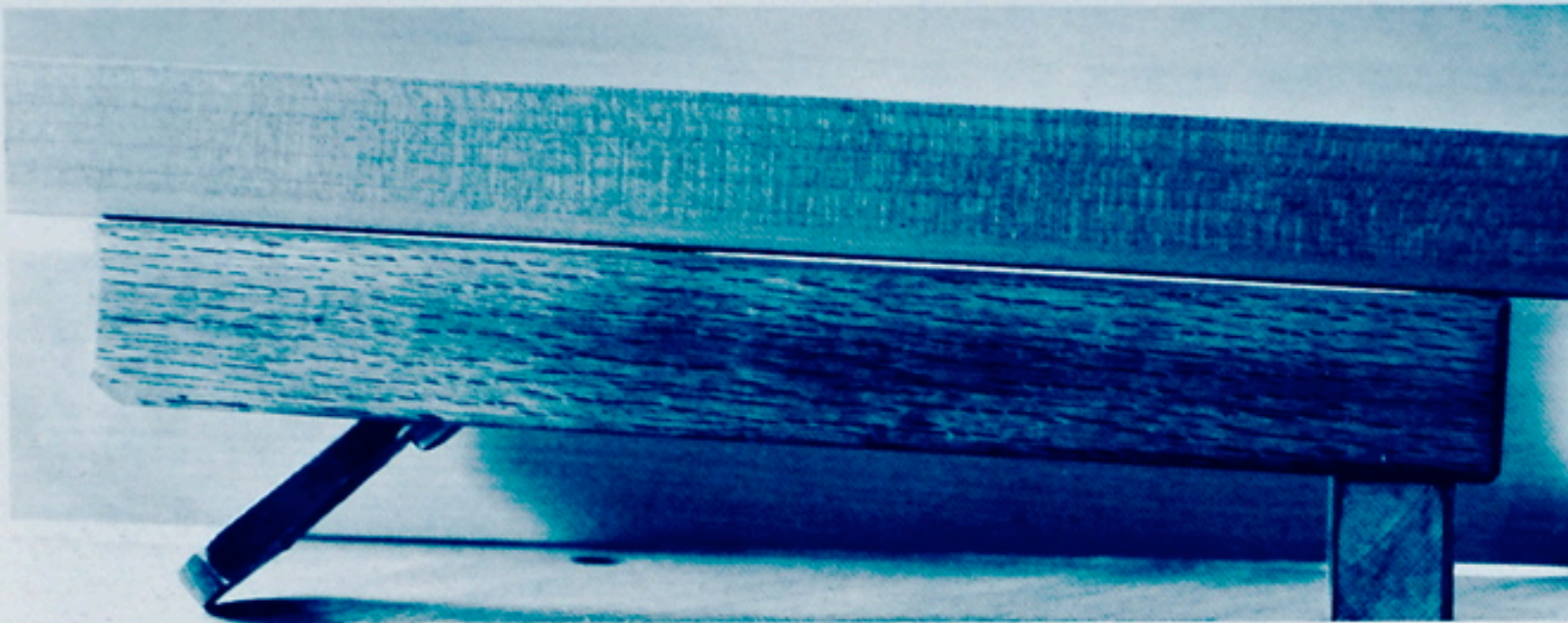


Top left: Points of contact for a smoothing plane; Center left: Incorrect smoothing configuration; there is no point of support immediately in front of the blade. Bottom left: Points of contact for a Joiner (long body) plane for truing. Relief has been exaggerated in all drawings in order to be more easily perceived. Right: end view. Top and bottom are incorrect configurations. Center is correct-no concave or convex curve across the width of the body.





*Left: Using the winding sticks to sight for winding in the plane body. Below: The configuration of the sole can be seen by placing a straight edge along the length of the body and observing the light.*



## Conditioning the sole

When a plane is not cutting smoothly, the cause of the problem is most often the condition of the bottom of the plane; either its lengthwise configuration or the flatness across the width need adjustment. I've often had students who marvelled at a plane which performed markedly better after we reconditioned the sole, when we didn't do any resharping. A wooden plane should always be checked before use to see if the sole is in condition. If you use the plane every day you won't have to recondition it very much at all each time you use it.

What's nice about wooden planes though, is they're made of wood so woodworkers can adjust them! One thing that helps me keep my planes stable is to store them in a wooden box, (see photos page 8) with their blades back-set a little, but in tension. When you condition the sole, make sure the blade is back-set a bit, so you don't nick the blade. But again, leave the blade in so the body is in tension.

## Rough, truing and finish planes

The use you intend for the plane should determine the configuration of the sole. The sole of a smoothing plane should

touch the wood immediately in front of the blade and at the very end, nowhere else. (See the drawings on page 9). Rough planes and finish planes are smoothing planes; in both cases you want to follow the contours of the wood to take a continuous shaving. The amount of relief behind the blade should reflect the plane's function. For rough planing, where you want to take off wood, you need more relief so the plane follows the changes in hardness in the wood and takes a continuous cut. For finish planing, you should be working with a board which is already flat, so less relief is needed. The flatter your stock and bench, the less relief you need behind the blade. In any case, gradual relief in back of the blade gives additional support and resistance to the pull of the wood.

By contrast, a truing plane (joiner plane) is set up to touch at the very back, and if it is a long body, at several high points in front of the blade. This is because your intention with a truing plane is not to take a continuous shaving, but to flatten the board.

Your first step in conditioning the sole is to check the body for twist. Lay a pair of winding sticks (see pages 12-13) on the sole, one just in front of the blade, the other at the front end.



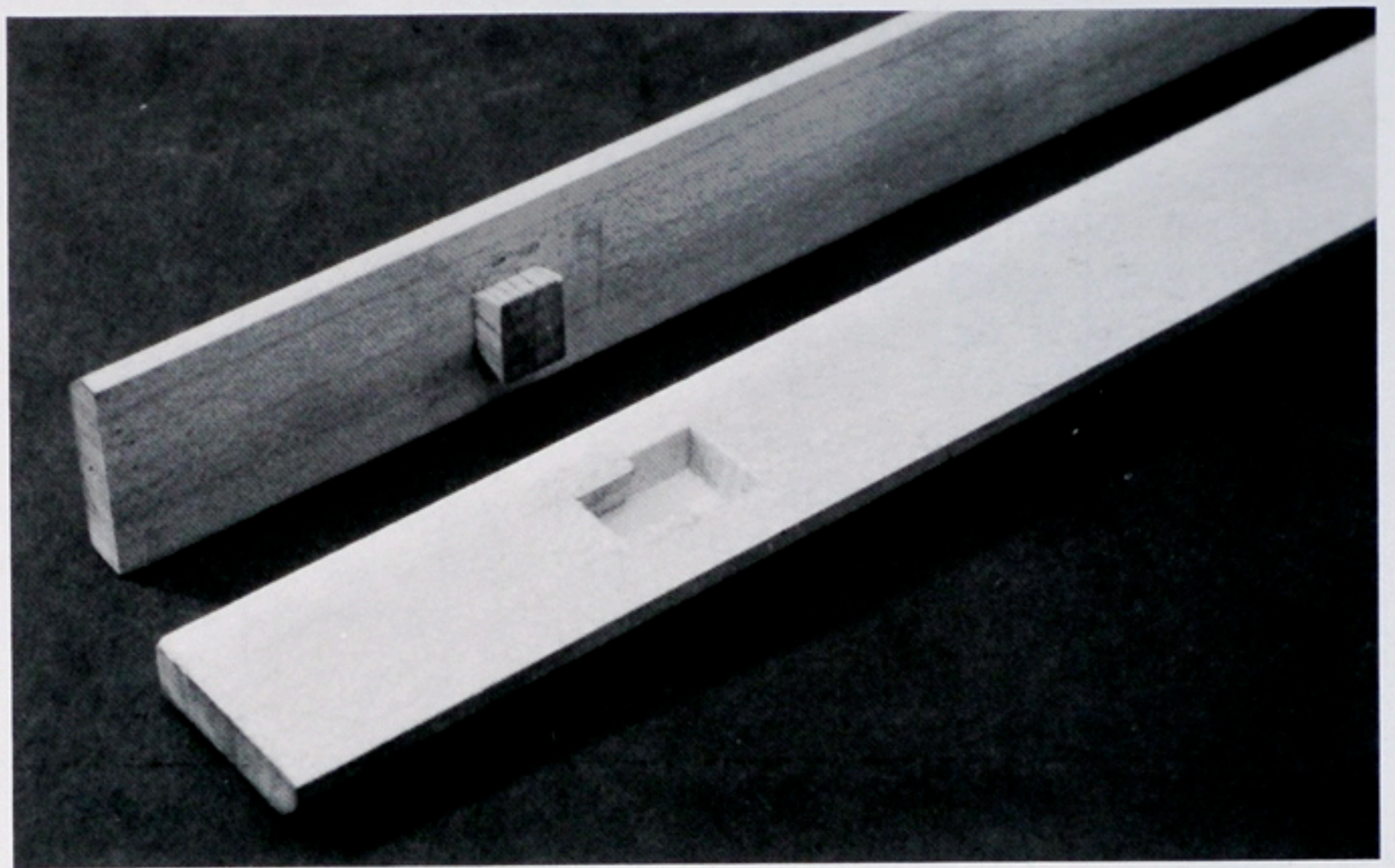
Getting your eyes level with the sticks, sight across the two top edges to see if the body is in winding. If the end of one stick is higher than the other, the plane body is twisted, or in winding. Use a scraper plane, working across the grain, to take very fine shavings and take down the high spots. You will notice that the side edges of the plane body are chamfered. This is to prevent splintering of the edge as you plane across the sole.

You can also use the winding sticks together swivelling them on the sole to locate high spots. This technique is useful when you set up the configuration of the sole for truing, rough or finish work. Another method is to lay the sticks along the length of the sole. Hold the plane up to your light source and look at the light as it comes between the winding sticks and the sole. This will help you to see the contours of the sole. The high spot in front of the blade should be right at the edge of the throat opening, and the relief down to the lowest point should be a straight, gradual incline. The point of contact immediately in front of the blade is to provide support just before the blade goes into the wood. If a plane feels grabby, the problem can

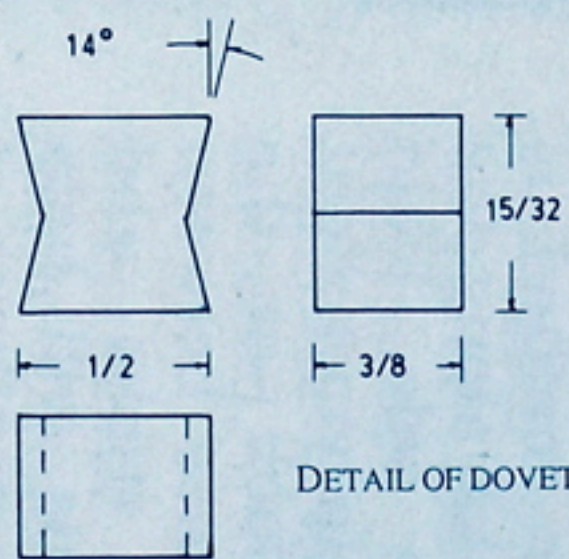
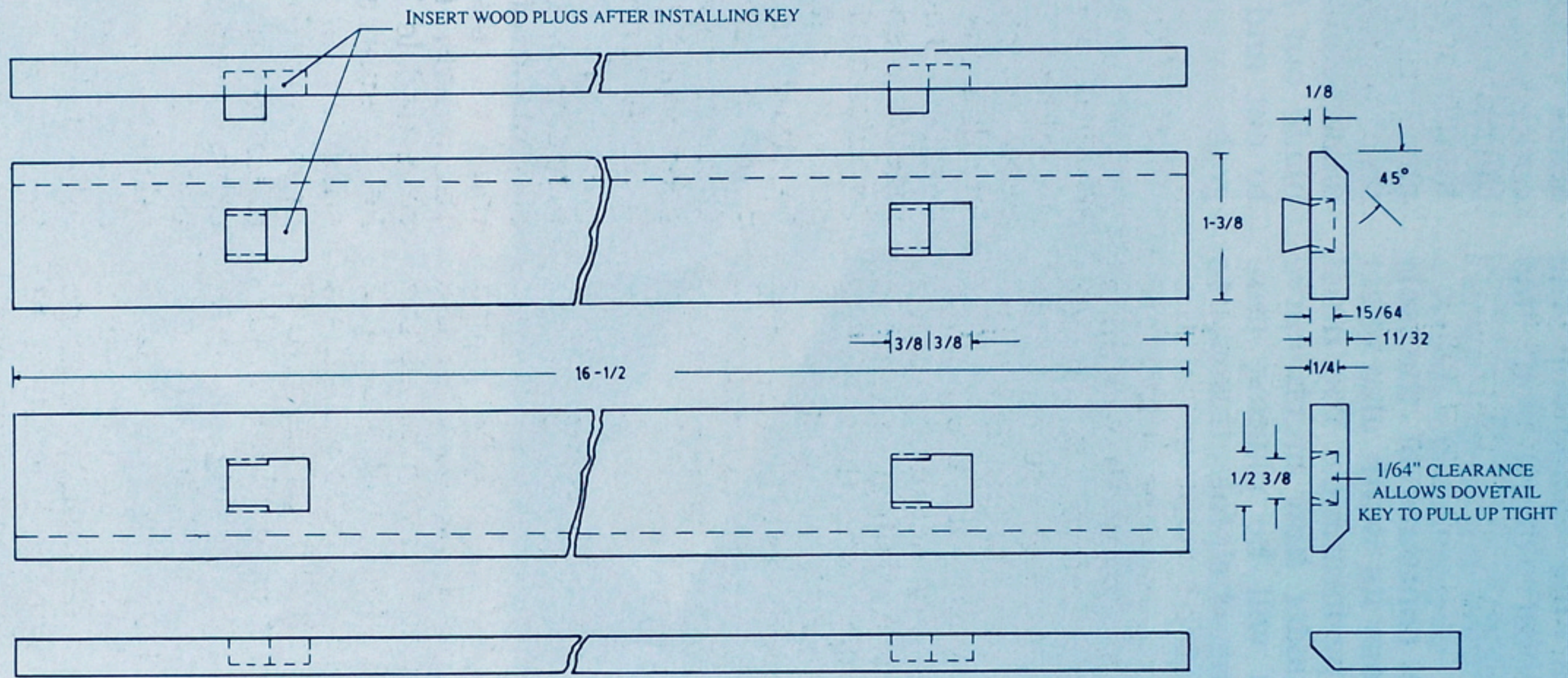
mean that this point of contact is too far away from the blade or the support drops off too quickly.

The contours of the sole across its width also effect its performance. You must consider how much curve you will be planing into. Some helpful things to

remember: if the sole is too high in the middle, it tends to cut in the corners a lot because the blade is blocked in the middle. The plane can also tip, side to side. If the sole is too high on the sides, you need to set the blade out farther in order to cut and the plane may grab.







ALL DIMENSIONS ARE IN INCHES

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WINDING STICKS	MAY-87	1/2"=1"	GY



## Preparing the stock

When your planes are set up for their various purposes, you can begin preparing the stock that you want to finish plane. The rough plane is used to remove the mill marks or to change the gross dimensions of the board. Think in terms of removing anything that would dull your truing plane, although plane marks can still be felt after rough planing. Rough plane both broad surfaces of the board, as well as the sides, chamfers and ends. This should be the procedure at each stage of planing.

Check the board for winding and cupping. As you did with the sole of the plane, you will remove the high spots. On a cupped board, these will be the ends of the concave side and the middle of the convex side. Again, pivoting the winding sticks will show you where the high spots are. You can also check the board for the pivot spots by swiveling it on a bench that has been kept true and flat.

If you make the board as flat as you can, the finish planing will go easier.

First plane with the grain, then across the grain, then on the diagonals, then with the grain again. For a board narrower than 8" across, just plane with the grain. Set the depth of shaving to get through most of the plane marks left by the rough planing. You don't want to set the shaving too fine; there are only so many strokes in a blade before it needs resharpening, so get the most out of it. Don't be concerned if the plane skips sometimes when you are truing. This is because of the truing configuration which is designed to flatten the board, not to take a continuous shaving.

## Finish planing

After the board has been trued and planed with the grain, the first pass of the finish plane will true the surface from the variations in depth left by the curve of the truing plane blade. Whether truing, finish planing, or adjusting the sole of a plane, never take two strokes in the same spot. Continually change the angle and location of cut. The very last pass with the finish plane, after planing both broad surfaces, the edges and chamfers, should be on

the broad surface of the board. You may want to sharpen with the finish stone one more time before this last pass to leave a flawless, shining surface.

## Winding sticks

Winding sticks are a pair of wooden straight edges, used to check a surface for flatness and straightness. They are made together, so that they are parallel and straight. The sticks can be pinned together or held together with a sliding dovetail. Quarter sawn poplar is a good wood to use for this project. When you have a pair of sticks held together in this way, you can plane off the edges of the two sticks at once. Then hold them edge to edge and look toward your light source. The inaccuracies in the straightness of the edges are doubled, so you can perceive them more easily. Use a scraper plane, taking off a fine dust, rather than a shaving, to take down the high spots. Repeat checking edge to edge until no light is visible between them. The edges are now straight and true to each other, and as a unit when pinned together.



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