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THE RONDAN JACKET SUPPORT CLAMP AND JACKET TRANSPORT SLED

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ABSTRACT: The RONDAN jacket support clamp and jacket transport sled are inexpensive, relatively easily fabricated tools which have proved invaluable for the field collection of large vertebrate specimens. Although there are some complicating factors, both of these tools have been used with great success to safely collect and transport numerous Jurassic dinosaur bones.

INTRODUCTION

The idea for the jacket support clamp came about as a result of having observed, on occasion, a large fossil being damaged in the field during the collection process. The damage occurred when the plaster jacket containing the fossil was being turned over to plaster the underside. Even though the matrix containing the fossil had been undercut as far as safely possible, and the top jacket applied and allowed to completely harden, there was not sufficient bottom support to contain the heavy contents of the jacket. Thus, after breaking through the jacket's pedestal, and, in the endeavor to turn the jacket over as quickly as possible, the contents simply fell out of the jacket. Our jacket support clamp sufficiently supports the underside of the jacket and thus prevents such disasters. The clamp we describe here ties everything together to form a secure package that can be turned over in a safe manner, without damaging or losing the contents of the jacket. After having been turned over, the clamp can be disassembled and the final burlap/plaster cap can be applied to the jacket. We have sometimes even left the jacket clamp in place, in lieu of plastering the bottom side, and loaded the entire package into a vehicle and transported it to the Museum.

The idea for the jacket transport sled was the direct result of the need for a way to easily move a large jacket from the collection site to a more accessible area or to a vehicle. A large jacket can be turned over onto the sled, the jacket clamp removed, and the final burlap/plaster applied. After the plaster has hardened, the jacket can be secured to the sled with chains, ropes, or ratchet-tie-down straps. By attaching a chain, rope, or steel cable to the sled, it and the jacket can be pulled by manpower, horses, or a vehicle to any location desired in order to load the jacket onto a vehicle. We have even, at times, left the jacket secured to the sled and loaded the whole package into a vehicle.

JACKET SUPPORT CLAMP

Components and Hardware Items

The parts that make up the RONDAN Jacket Support Clamp are separated here into two categories for clarification and ease of description. A component is a part that has been manufactured by Ron Peterson or a part that has been purchased and altered by Ron to accommodate our needs. The hardware consists of items that are commercially available at most hardware stores. Because all components and hardware items are constructed from U.S. hardware and machine shop materials, we use English, rather than metric, units.

Component A: Automobile Leaf Springs

Automobile leaf springs (Fig. 1) are inexpensive and easily obtained from an automobile junkyard. Different springs vary from 1/4 to 3/8 inch in thickness. Our springs vary from 2 1/4 to 3 inches wide and from 14 inches to 52 inches in length. A variety of lengths is desirable because of the difference in size from one jacket to another. We maintain a total of 24 springs. The longer leaf springs will need to be straightened prior to being drilled and used in the field. This can be done by a machine shop or any business that has a hydraulic press. One end of each spring needs to be sharpened to a chisel edge so that it can be driven through

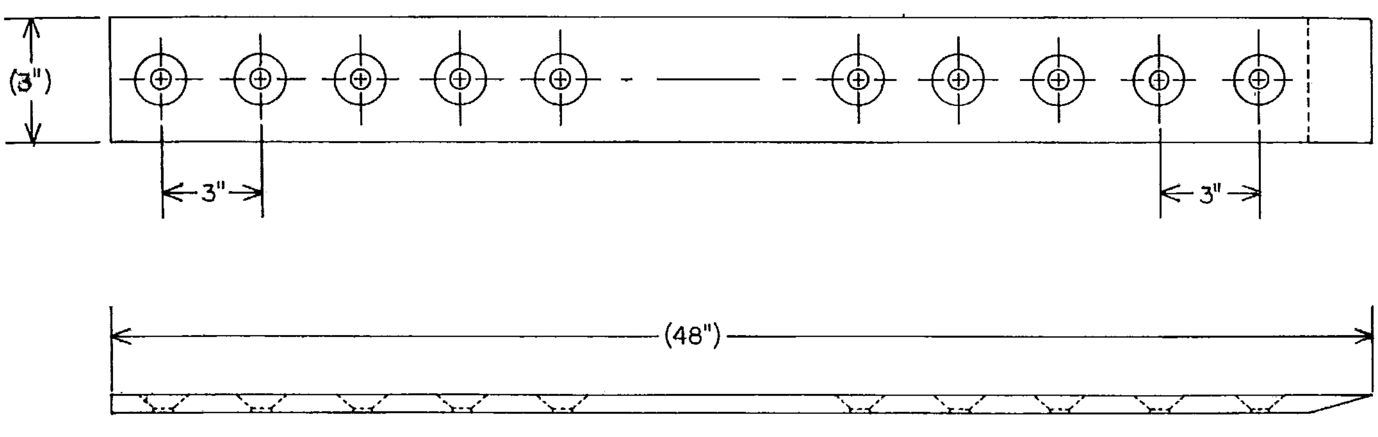

FIGURE 1. Top and side views of one of the longer modified leaf springs.

the pedestal supporting the plaster jacket. Clearance holes for bolts need to be drilled through and along the center line length of the spring. Holes do not need to be drilled the entire length of the longer springs, as the center section of the springs will not be accessible once they have been driven through the pedestal. It is advantageous to maintain a uniform spacing between the holes drilled in all of the springs. This uniform hole spacing makes it easy to bolt the springs together, if necessary. The holes in all of our springs are spaced 3 inches apart. The clearance hole diameter is 13/32 inch for the 3/8 inch diameter flathead screws that we use. The holes have a countersink to accept the flathead screw. It is not necessary to countersink the holes if standard hex head bolts are to be used. The number of holes in each spring depends upon the overall length of the spring, the spacing between the holes, and the discretion of the designer or user.

These leaf springs can be driven by a sledgehammer. We have constructed caps to bolt over the dull (driving) end of the spring, but found that they are not efficient to use in the field. Usually, after the spring is set into position and driven in a few inches with a small (4-6 lb.) sledge, we have found that most persons can drive the springs with 8-20 lb. sledges. As with any endeavour using hardened steel, we recommend that all nearby personnel utilize eye protection when the springs are driven under the jacket.

Component B: Slotted Anchor Bar

The jacket clamp requires two slotted anchor bars (Fig. 2). These are made from aluminum plates or bars in order to reduce the weight of the assembled clamp. Slotted anchor bars should be 3/4 inch thick, for strength, 48 inches long, and 3 inches wide. The aluminum can be obtained from a metal supply business, a scrap metal business, or a machine shop. A machine shop may be required to manufacture these parts. The anchor bar has a 1 inch wide slot cut through it, centered on the 3-inch width. The slot is 44 inches long and is centered on the 48-inch length. Clearance holes for bolts and other hardware are drilled through the bar, centered on the 1 inch wide web on each side of the 1 inch wide slot. The hole diameters are 13/32 inch, and the holes are spaced 3 inches apart. The holes are drilled along the entire length of the 1 inch wide web on one side of the bar. Fewer holes can be drilled through the opposite web. Our anchor bars have 12 holes drilled through one web. The opposite web has 10 holes and they have been countersunk to accept our flathead screws, if needed. The slot, by itself or in combination with some of the holes, is used to bolt the bar to the leaf springs that have been driven through the pedestal. The ideal positioning of the leaf springs and anchor bars is illustrated in Figure 3. Eye bolts are bolted into the holes that are not used to secure the bar to the leaf springs. Chains, ratchet tie-down straps, or ropes can then be attached to the eye bolts and tightened around the jacket to make a secure package.

Component C: Square Aluminum Washer

When all of, or a portion of, the 1-inch wide slot in the anchor bar is used to bolt the bar to the leaf springs that have been driven through the pedestal, large washers are needed to span the width of the slot. For this purpose and because of the weight factor and for strength, our washers are made from 1/4 inch thick aluminum (Fig. 4). The aluminum can be obtained from the same sources as that for the slotted anchor bar. They are 2 inches square and have a 13/32 inch clearance hole drilled through the center. We also have a smaller size, 1-1/4 inch square, that are used in other areas of the clamp as needed. Because of frequent loss and damage, we maintain large quantities of both washer sizes.

Hardware: Description and Nomenclature

The hardware listed here (Fig. 5) has worked well for us in the field. However, all hardware is subject to change due to personal opinion, experience, and availability. All hardware should be high quality, strong, and possess a high stress capability.

1. Item D - socket flat countersunk head cap screw. The thread size is 3/8-16. The 3/8 designates the screw or bolt diameter and the 16 is the number of threads per inch (pitch). We have a variety of lengths, from 1-1/4 inch up to 2-1/4 inch long.
2. Item E - plain hexagon nut, 3/8-16 internal thread.
3. Item F - S-hook, 1/4 inch diameter.

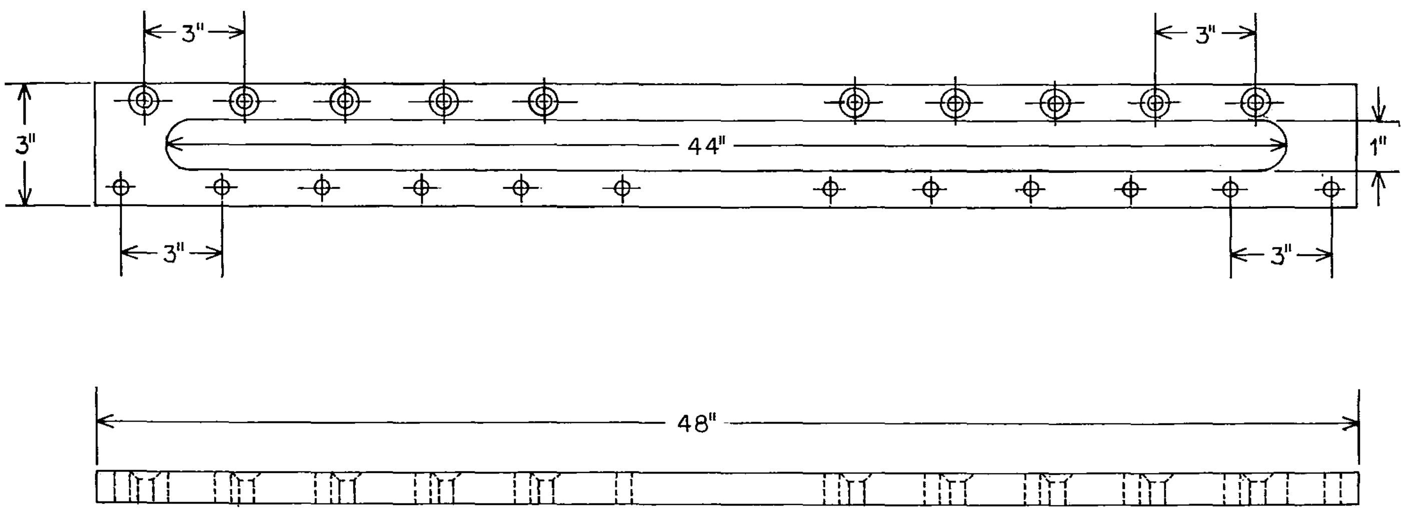

FIGURE 2. Top and side views of a slotted anchor bar.

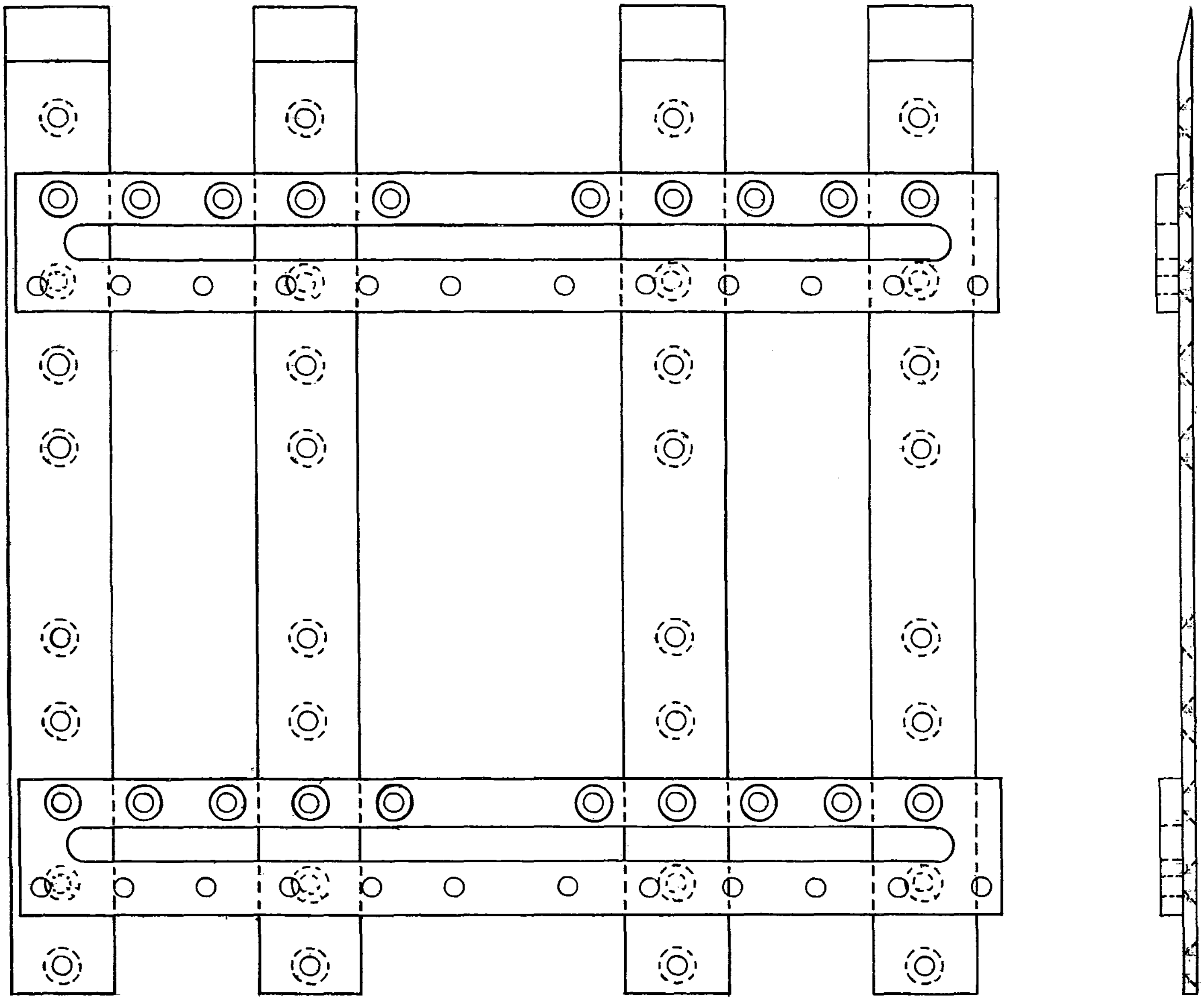

FIGURE 3. Top and side views illustrating the ideal positioning of the leaf springs and anchor bars.

4. Item G - turned eye bolt, 3/8-16 thread. We use eye bolts that are 6 inches long.
5. Item H - eye/eye turnbuckle, 6 inches long or longer. The opening in the eyes must be large enough to accept the 1/4-inch diameter S-hook. Some brands of turnbuckles have hooks instead of eyes. The turnbuckles are used to tighten the chain, which is attached to the eye bolts with the S-hooks, around the jacket.
6. Item I - ratchet tie-down strap. The name of this item may vary from one manufacturer to another. These items come in different lengths. They are used to secure the jacket to the clamp. We now prefer to use these items, in place of the chains and turnbuckles, as they are much easier to tighten around the jacket and are much lighter and less cumbersome than the chains. We have 8 of these. At least four should be available.
7. Item J - welded steel chain, the thickness of the links to be 3/16 inch or thicker. The inside width of the chain links

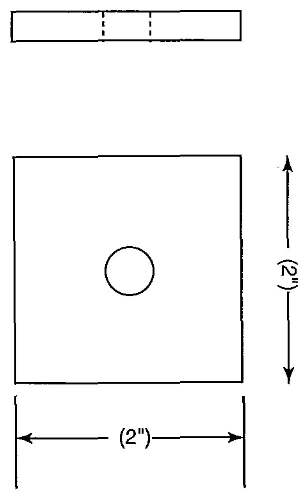

FIGURE 4. Side and top views of the square aluminum washer.

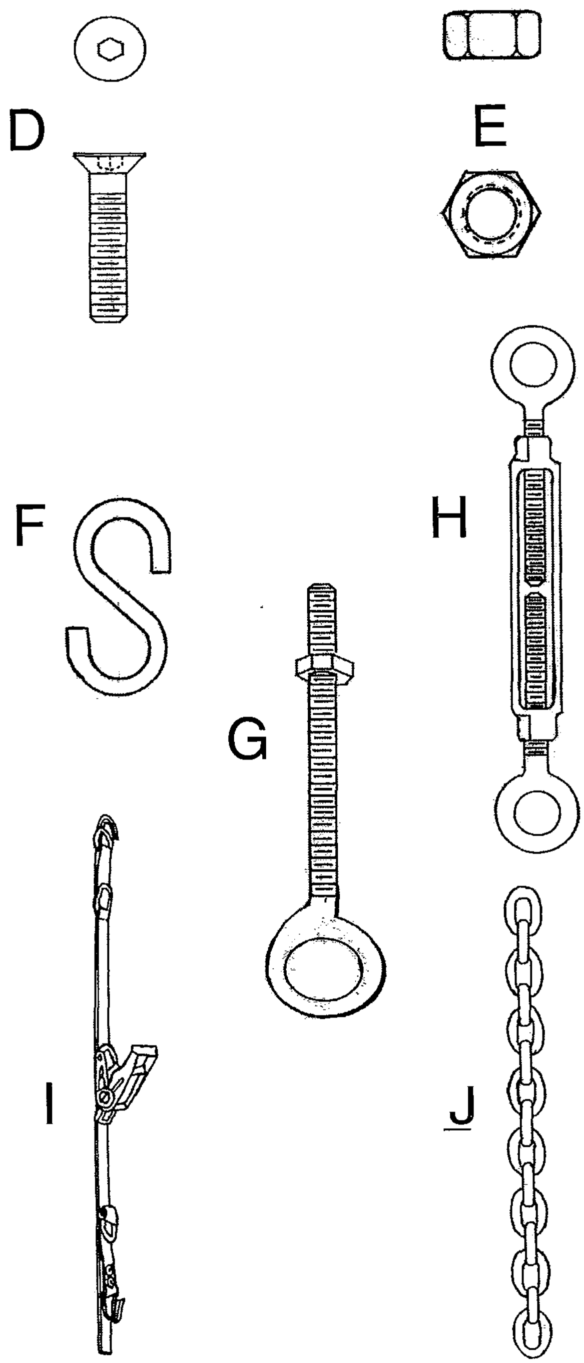

FIGURE 5. RONDAN jacket support clamp hardware: **D**, socket flat countersunk head cap screw; **E**, plain hexagon nut, **F**, S-hook, **G**, turned eye bolt, **H**, eye/eye turnbuckle, **I**, ratchet tie-down strap, **J**, welded steel chain. Drawings not to scale. See text for details of individual item size, threading (pitch), and other specifications.

must be large enough to accept the 1/4-inch diameter S-hook. We use a variety of lengths of chain, the longest being 7 feet long.

Tools for Jacket Clamp Assembly

The tools described here are the ones needed to assemble the RONDAN jacket support clamp, using the hardware illustrated in Figure 5. Different tools may be required for assembly if different hardware is substituted. The tools have not been illustrated here, as the authors believe that tool nomenclature is common knowledge. The tools required are: (1) a hex wrench (Allen wrench) of a size to fit the socket of item D; and (2) an open end or box wrench, the size of the hex nut, item E. More than one of each of these tools will be useful in the field. Other tools that we have found to be invaluable are pliers, screwdrivers, and an adjustable wrench (crescent wrench). The photograph in Figure 8 shows the RONDAN jacket support clamp applied to a jacket at NMMNH L-3282. The assembled clamp is shown in the Figure 9 illustration.

JACKET TRANSPORT SLED

Materials and Fabrication

The materials needed to fabricate the jacket transport sled are inexpensive and easily obtainable. The main part of the sled is an automobile hood from an older model automobile. This can be purchased from an automobile junkyard. A length of square steel tubing and steel pipe will also be needed. These materials can be obtained from a metal supply business or a scrap metal business. The lengths required for these materials is determined by the size of the hood and the number of anchor loops desired. Pieces of the square steel tubing are welded to the underside of the hood to add strength and provide a rigid frame to which the anchor loops are welded. We use 1-inch square steel tubing that has 1/8-inch thick walls. The anchor loops are made from the steel pipe. We use pipe that has a 4-inch outside diameter and a 1/4-inch thick wall. We also use a piece of this pipe for the tow ring. It is welded to the curved front of the hood. The pipe is cut into 1 inch long sections and the pieces that are to be used for the anchor loops are then cut in half, thus making two anchor loops from each 1-inch section of pipe. The sharp edges of the anchor loops and the tow ring will need to have a radius put on them to prevent them from cutting the ropes and tie down straps that are attached to them.

Our tow ring and anchor loops have a full radius on the edges, as illustrated in Figure 6. The ends of the anchor loops do not need a radius, as they will be welded to the square steel tubing. The number of anchor loops and tow rings welded to the sled is optional. Our sled has one tow ring welded to the front center of the hood and 12 anchor loops welded to the square steel tubing framework. The positioning of the tubing, anchor loops, and tow ring on our sled is illustrated in Figure 7. All of the parts that make up the sled, except for the tow ring, can be seen in Figures 9 (schematic) and 10 (photograph).

DISCUSSION

In the following sections we briefly discuss the utility and limitations of both the RONDAN jacket support clamp and the jacket transport sled.

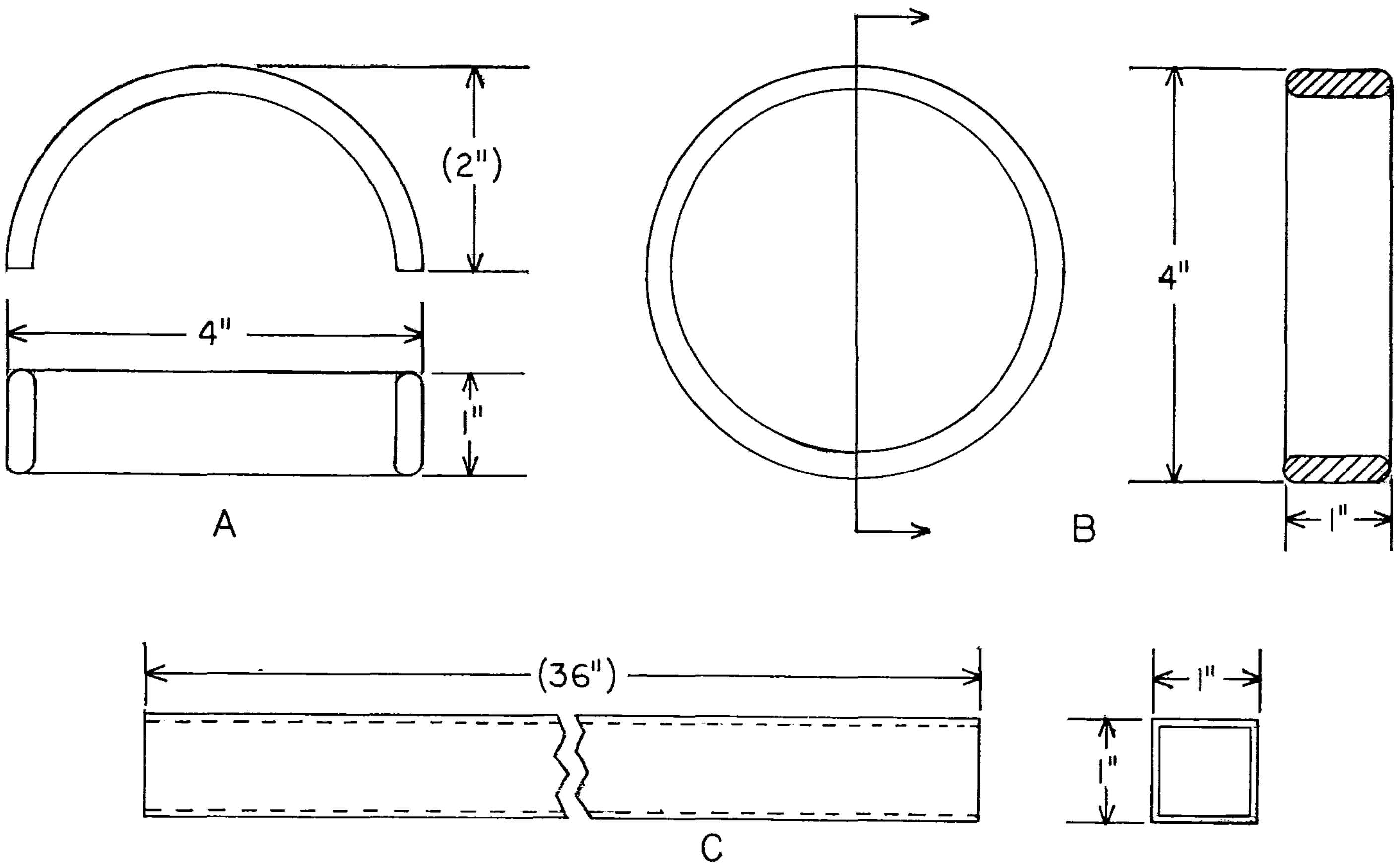

FIGURE 6. Views of the parts to be welded to the hood. **A**, anchor loop. **B**, tow ring. **C**, square steel tubing.

RONDAN Jacket Support Clamp

Collecting a jacketed fossil in the field can be a simple or difficult task, depending upon many variables. The location of the site, the matrix containing and surrounding the fossil, the complexity of the site or fossil bed (fossils articulated, isolated, or in close proximity to each other), the size of the jacket, and other variables all dictate the difficulty of the task. These variables, in conjunction with the characteristics of the RONDAN jacket support clamp, govern the usefulness of the clamp in the field.

The RONDAN jacket support clamp has been field tested extensively at the Peterson Quarry, NMMNH L-3282, a typical Morrison Formation dinosaur quarry, as well as at two Chinle Group localities, NMMNH L-3764, the Krzyzanowski Bonebed, and L-3845, the Snyder Quarry.

At the Peterson Quarry most bones are disarticulated, large (approximately 1 m in length) and occur in a well-indurated sandstone. Jackets typically contain one or two sauropod bones. Thus, the RONDAN jacket clamp has proved extremely useful, as each fossil is excavated, pedestaled, jacketed, clamped, flipped, and removed in the fashion we have documented here. Notably, the security of the clamp allows jackets to be flipped by fewer people than normally necessary, because the speed at which the jacket is flipped is not critical. This has proved useful at the Peterson Quarry, as there is not always room to assemble a large crew to flip jackets near the highwall. We have also utilized the leaf springs at the Peterson Quarry independently as oversized chisels to remove sandstone overburden and matrix.

The Krzyzanowski Bonebed consists of a rich assemblage of small reptile bones, with no one element greater than 6 inches (15 cm) long. The matrix at this site is a typical Chinle bentonitic mudstone, with extensive fractures that occur in a variety of planes. The soft and fractured nature of this bedrock would normally limit the size of the jacket, as it is very difficult to undercut the pedestal without experiencng extensive collapse and sloughing of the sides. However, we chose to cut large jackets from the surrounding matrix "blind," hoping to preserve as many bones as possible by minimizing the total number of trenches between jackets. We utilized the RONDAN jacket support clamp here to remove a particularly large (over 1,000 lb.) jacket. Notably, after assembling the clamp on the jacket we were able to use the electric winch on the front of our Museum's HumVee (military truck) to flip the jacket. The clamp provided sufficient stabilty that we thus flipped this jacket in a slow, controlled fashion, greatly reducing the danger of injuring persons when trying to flip such a large jacket by manpower alone. This jacket could never have been recovered using conventional undercutting methods.

The Snyder Quarry is a similar Chinle Group locality, except that here the bones occur in a soft, intraformational conglomerate that is locally underlain by a well-indurated sandstone. We utilized the clamp here to facilitate flipping a moderately large (approximately 800 lb.) jacket containing a phytosaur skull and numerous other elements in this rich bonebed. Here we were able to use the eye bolts of the RONDAN jacket clamp to secure long

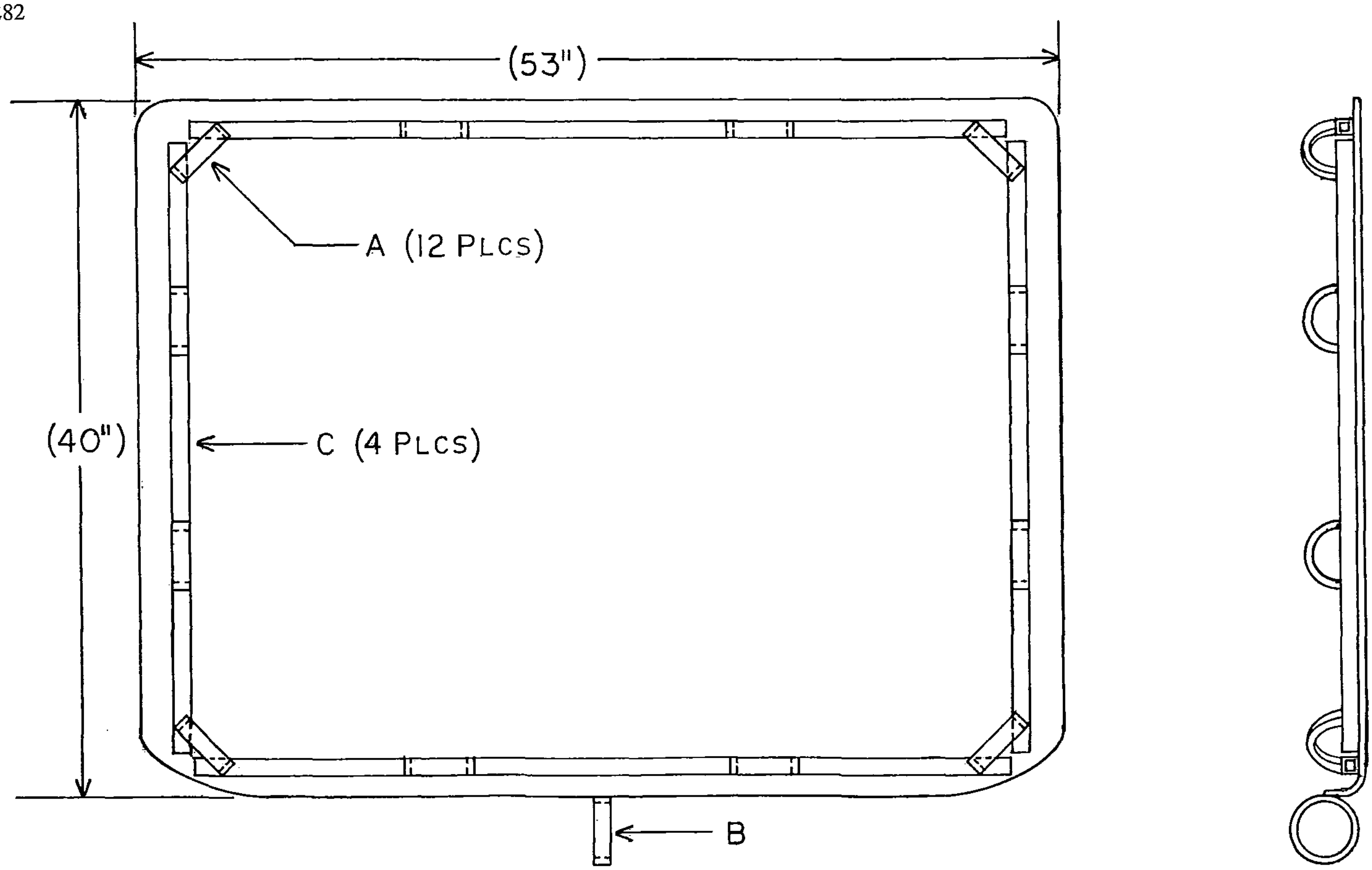

FIGURE 7. Top and side views of the RONDAN jacket transport sled.

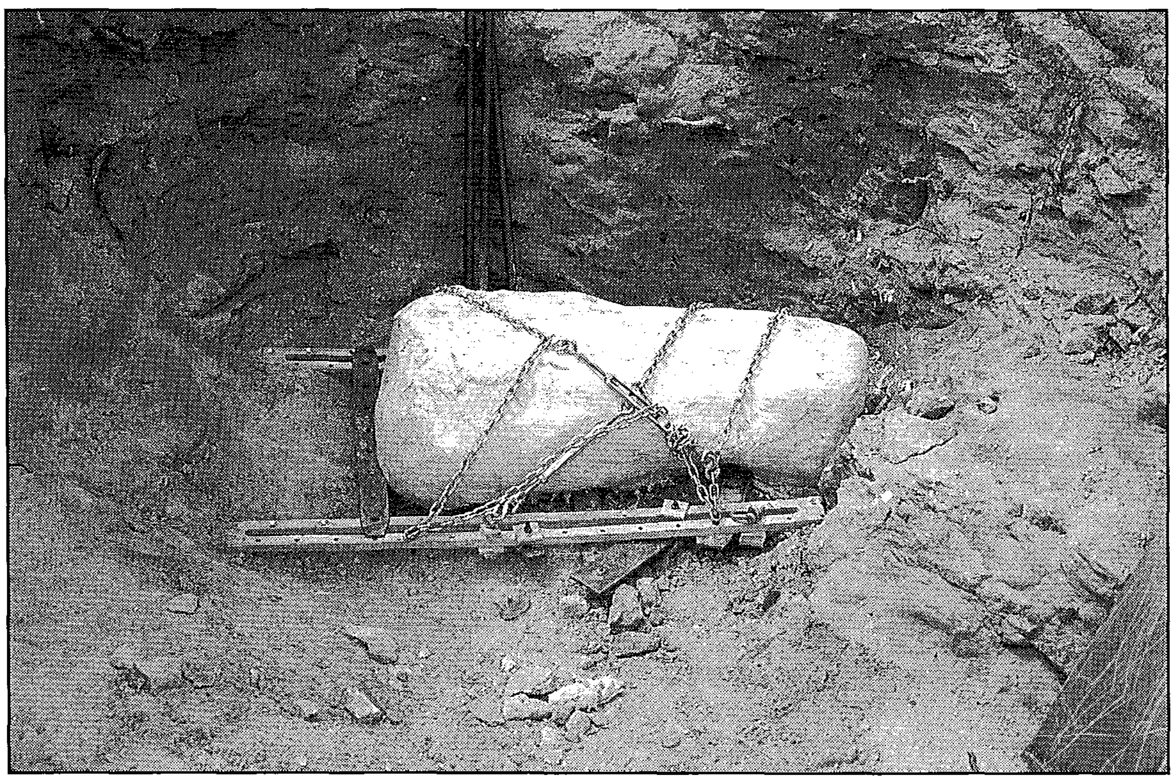

FIGURE 8. Photograph of a large jacket, clamped and ready to be turned over.

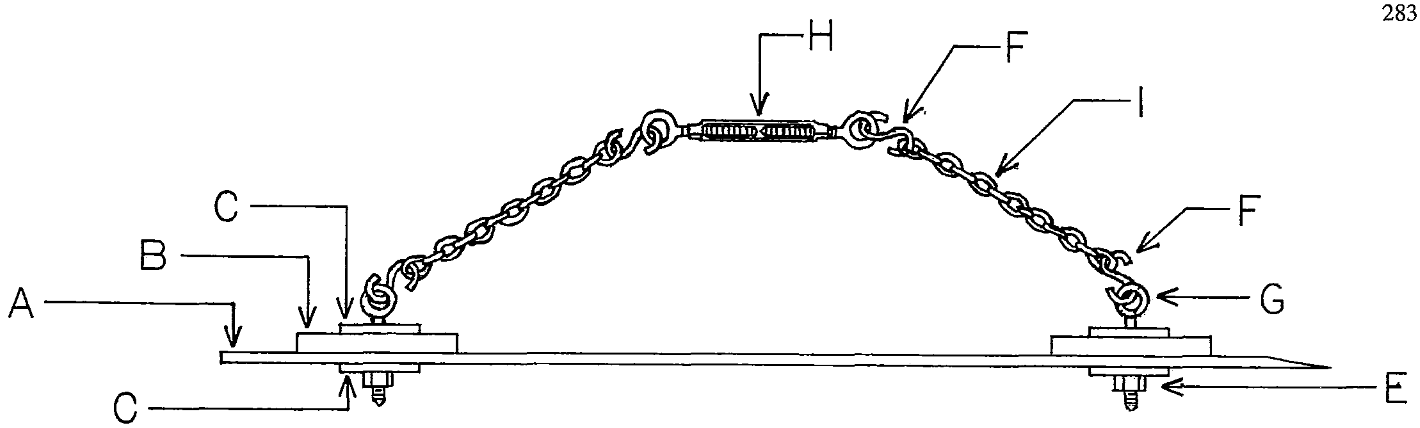

FIGURE 9. Section view illustration of a clamped jacket with the assembled components and hardware of the RONDAN jacket support clamp in place. Item D is not shown.

ropes to the jacket and flip the jacket manually using numerous persons in spite of the presence of a prominent highwall.

In spite of its usefulness, there are five main disadvantages to the jacket clamp: (1) the clamp is made up of many parts and several tools are required for assembly; (2) when combined, the components, hardware, and tools constitute a heavy package to manually transport to remote sites; (3) a larger than normal area around the jacket must be cleared in order to have room to drive the leaf springs through the pedestal and to turn the clamped jacket over; (4) the clamp adds extra weight to the jacket; and (5) in softer (Chinle) sediments, it is sometimes difficult to control the vertical distibution of the springs, which may dive or, of greater concern, climb, as they are driven under the jacket.

Therefore, use of the RONDAN jacket clamp is not always practical. Notably, all of the sites that we have used the jacket clamp at thus far are readily accessible by vehicle, negating most of these disadvantages. We note also that, although the clamp requires much room to assemble, it provides a means by which ropes, cables, and other tools may be anchored to the jacket, increasing the number of persons or mechanical devices that can be used to flip the jacket in otherwise tight areas, such as where there is a pronounced highwall or fragile and exposed fossils.

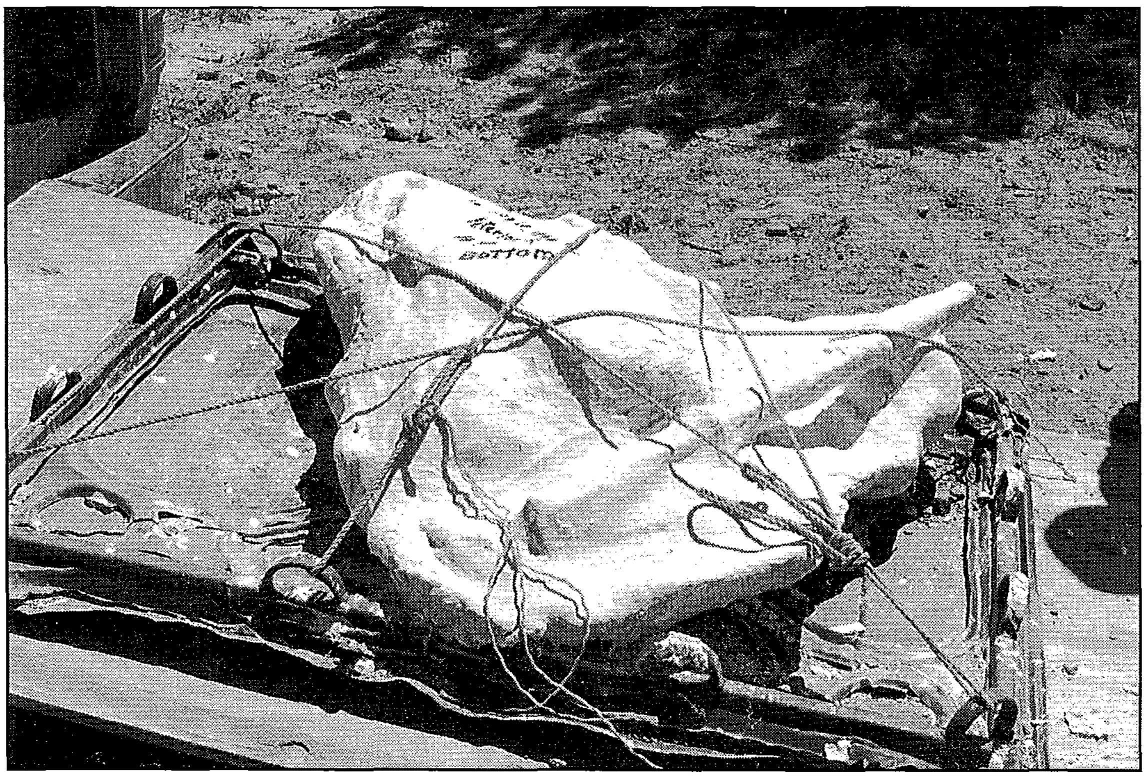

FIGURE 10. Photograph of a large jacket secured to the RONDAN jacket transport sled. The jacket was turned over onto the sled while still in the quarry. The bottom of the jacket was then plastered. After the plaster had hardened, the jacket was secured to the sled with ropes. Using the plywood as a ramp, the loaded sled was then towed out of the quarry with a vehicle. The same plywood was also used as a ramp to load the sled and jacket onto a vehicle.

Thus, we have found the RONDAN jacket support clamp to be invaluable on many occasions, and expect to use it at more remote and/or inaccessible localities in the future. We have overcome and/or put up with the disadvantages of the clamp many times to collect safely and successfully large jacketed fossils that may have otherwise been damaged or destroyed during the collection process. We feel that proper construction and use of the clamp essentially guarantees successful flipping and recovery of jackets in the field, and thus is worth its added weight and time requirements.

RONDAN Jacket Transport Sled

Of the collecting variables discussed above, only the site location may have an impact on the usefulness of the RONDAN jacket transport sled. Whenever possible, we attempt to flip a clamped jacket directly onto the sled. Although carrying the sled for a long distance over rough and rugged terrain to and from a remote locality may not be ideal, we feel this is still preferable to the alternative, namely hand-transporting the jacket over the same terrain.

At most localities, the jacket transport sled is invaluable. Once a jacket has been secured to the sled with ropes, chains, or ratchet tie-down straps, and a rope, steel cable, or chain has been attached to the tow ring, the loaded sled can be pulled up a steep slope, out of a quarry, or over rough terrain to a more accessible area where the jacket can be loaded onto a vehicle. On occasion, we have even loaded the whole package (jacket, jacket support clamp, and transport sled) onto a vehicle. A ramp of some sort will be needed when pulling the loaded sled out of a quarry or from a site where vertical walls exist. We have constructed ramps made of earth and/or sheets of plywood. The plywood we use is the standard four by eight foot sheet, 3/4-inch thick. It is helpful and sometimes necessary to manually direct and guide the sled in the direction that it is being towed. This is accomplished by attaching a rope to each anchor loop on the far corners of the sled, opposite the tow ring side. With one or more persons handling each rope, the rear of the sled can then be manually pulled in the direction necessary to help guide it up a ramp or to keep it in alignment with the direction of tow.

We use the jacket transport sled extensively and whenever possible. It has saved us much backbreaking work and manual labor when collecting large and heavy jackets. Although we have not yet tried it, we note that pack animals could be used to pull the jacket sled in Wilderness Study Areas or other locations in which mechanized jacket transport is not possible. To date, we have amazed more than a few seasoned field volunteers by the ease of which we retrieve a large jacket from a site, using the RONDAN jacket transport sled.

ACKNOWLEDGMENTS

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