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Crabtree: There are quite a few potlids on the outside and the flakes of that one single core seem to be much brighter, but that was only a single example that was all of the materials that they had, so there wasn't sufficient evidence to know that there was any particular time that this took place. ....it would cease at certain level in Europe where this had arrived. It is apparently very ancient in the Americas, because the Folsom was, no doubt, altered. Many of them were and you find the color changes and even the Clovis appears to be. Yet, again, with other groups of people it is not in evidence at all even in the Americas. So you wonder what the distribution of thermal treatment was. Not too much research has been done on it so far, and it will be interesting to find out at sometime what the extent of thermal treatment was and how far it reached. Now I have one from Oaxaca in Mexico - a white jasper or white agate point that had been altered because one of the original facets was still adhering and one could see the difference in original texture and that altered. You'll find these on the ventral side, the under or the curved side, where it wouldn't be flaked entirely across and there would still be some of the original material. Showing what it looked like originally, before it was flaked. Even on the backs, you may find some surface where they have a hinge fracture, or a little miscalculation, so that the whole surface wasn't removed. If it wasn't all removed and there is a change in lustre of the chipped surface and the original facet, then it is quite evident that there was altering taking place. What's nice is an artifact that has the outside of the flake on one side which is very coarse and granular and on the underside they will be very shiny and lusterous. When they were trimming the core, after it was heated, they'll take the outside off and then one can see the difference in lustre of the original and inside treated material. But with a single flake it is almost impossible to tell and it is better to have assemblage of them before one decides definitely about thermal treatment. On the outside of some of our jasper nodules in the States, like some of the French material, right at the cortex you'll find a combination of silica jells (opal), with a high content of water and cryptocrystalline silicas, which is actually opal, or a combination, on the outside. Now opal just is not suitable for artifacts. I mean you can flick it with your fingernail. It is soft, and you can scratch it with a file it has no ~~change~~ strength at all and with any heat change, it goes all to pieces. By the way, this artifact is one out of opal and opal can be worked. There are, no doubt, some points made of opal, but many of the points are made of white treated jasper and have almost the same refractive index and lustre of opal and, therefore, can be confused with opal. But it is really one of the jaspers, and agates, and chalcedonies. All of these are pretty much the same, with the exception of other colorations coming in and some foreign material and you will get a concentration of some other chemical salts, that will make the thing opaque, which turns it into a jasper. But there is one type of jasper that I can't get altered. I don't know why for the Indians were able to alter it. There is something that I have been doing wrong with that particular stone. They had a great skill in altering materials. This was a science with them, this altering of large blocks of stone and they knew how to raise the heat slowly, and cool it slowly. The larger the block the more slowly you must heat and cool. But small flakes could be altered in a few hours. By that, I mean, a half a day. At home, I start heating in the evening and the next morning they have cooled down sufficiently. I cover them with fine blow sand so it

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fills in all the cracks and lets the heat soak in evenly all the way around.

Phil Smith: Don, does it look as though the Indians were accustomed to heat treating the blades or preforms or something of that sort, or do they do the whole nodule?

Crabtree: Well, in some cases you find evidence of treated cores. Of course, the Hopwellians heated the whole core and it had a much sharper edge. The finer they could make the material by altering, the finer the texture, the sharper the edge. Like this flint here - where it is not shiny, it is not nearly as sharp on the leading edge. You'll see little striations I mean little saw tooth marks - but obsidian or a glassier material produces a sharper edge, because the fracture breaks out to infinity. If you have little granules in the material, the flake is not going to be nearly as sharp and smooth as if it were a very fine-textured material. Most evidence that I have seen has been in preforms that have been heated. Or, they will take a whole series of flakes and thermal treat them and then rework the flakes. Then, again, you'll find fairly sizeable treated flakes, I mean, this long and this wide, that had to come off a core. However, I have not found the core. I'm not an archaeologist and I'm not out looking. I would rather stay at home and chip the stuff then to go out and look. When I was a boy, I would go out hunting if there was a blowout in the blow sand I would gather, of course, what I saw on the surface. I was after chips and flakes as much as artifacts. This is one that Dr. Bordes was working on. This is quite good evidence of alteration. We have removed a great deal of the surface, but on this side you can see the contrast between heated and untreated material. This is the untreated material as it occurs in its natural state. It's very tough material it has been treated. I'm sorry, I meant to bring an untreated piece to show the difference in character. But we'll pass this one around and there should also be an artifact someplace here of this material. This hasn't been heated enough but this is pressure worked. You can see that this treatment changed the material and produced a better stone than this original piece. But in its natural form it is extremely tough. You can hardly take a flake from it, but this had a better alteration. This is evidence of over-treatment. I mean it got too hot on that edge, probably was too close to the element and this piece popped out.

Daugherty: Do you feel that the temperature was too high or it cooled too quickly?

Crabtree: He must have had great control to have altered as large a piece as he did. And he understood almost exactly how much heat was necessary because there is a wide variety of the water content in stone and the degree of temperature will vary with each material. Now, for instance, one type of chalcedony which has a replacement of silica jell, will not stand very much heat. However, if properly controlled, it will alter beautifully and be very waxy and lustreous and almost jewel-like. While the agate nodules formed in the vesicules of the ancient lava rocks apparently have micro crystals forming from the outside toward the center, leaving these patterns. These are called fortification agate. These will stand much more heat than those formed by a silica jell deposit.

There are no lines or patterns in the silica jell type of chalcedony. But there is even a wider variation of chalcedony. A friend in Montana said he didn't think anyone could ever flake Montana agate. He said he saw artifacts, but it appeared that they were of another material rather than Montana agate. He was quite enlightened when he found that Montana agate could be worked after it was treated. He hadn't developed his notching technique because he couldn't get enough pressure inside of the notch, but I expect now he will try it on the treated stone. So he felt that they made there artifacts all lancelot in shape because they were of flint and agate and the stone would not allow the pressure needed for the notching technique. There is a little story that goes with this artifact. This is a genuine - not one I made. But this is, apparently, a type of Solutrean flaking. At one end of the Camas Prairie in Idaho, the Clovis and some of this very beautiful work was done. This will give you an example of the thinness of some of these great big chalcedony disks they made. However, this piece, apparently, wasn't heated by the same people that made the Clovis, for we found this in another site of a more recent occupation, at the other end of the valley. They had salvaged this material, apparently, from an ancient site and brought it to their camp and did a little retouching after they had heated it, which is an odd thing. With this one, you might examine the edges, and notice that whoever did the work originally did the flaking on stone in its normal state.

Cambier: Asks question in French.

Phil Smith translates: Don, what are the major temperatures that you use in this heating?

Crabtree: I'm finding now over a long period of time that 450° will work on most materials. But it must be built up very slowly, I mean, it shouldn't go over 200°, initially, for at least an hour. At 200° for an hour and then raised to from 400 to 450. However, it will stand up to 900°.

Epstein: When you put it in a pot, can you tell us something about how you do this?

Crabtree: I use my wife's deep fryer. Just recently I discovered this great invention. Now she's lost her deep fryer. Prior to that, I had used a ceramic oven, which will go up to 1500°F or maybe 2000°F. And the breaking down point of this material, or a translucent agate like this, is around 1200°F. At 1200°F, it will all turn white. You may have found examples of this in your sites. Prehistoric man was able to build up that much heat in his pit, for you will find flints that have been entirely decomposed by heat. They used charcoal, possibly, or maybe by fanning it, or something like that. But at that heat it breaks down into little cubes and it entirely disintergrates and appears to be like porcelain. You can heat a translucent chalcedony, and at 1200° it will disintergrate and go to pieces.

Epstein: More clarification. Do you, for example, do you just keep the pieces in the pot or do you put sand in there?

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Crabtree: I cover it with sand. With the sand it retains the heat for a number of hours. I put it in the oven early in the evening - raise the temperature to 450°F., and then I turn the thing off at 11:00 p.m. By morning it is still warm, but you can reach in and get it without being burned. It's workable then and can be handled. But if you open the oven door before this lapse of time, the air touching the stone will cause it to pop and crack.

Epstein: Even in the sand?

Crabtree: If it is near the surface or exposed. But as I have told my wife I need a stethoscope. I could then sit by the oven and turn up the heat and listen and when I hear the first crack I turn the thing off. Like this. Then I would know if I was heating it too fast. Perhaps they had their ear to the sand and did the same sort of thing.

Wormington: Is there any advantage to working while it is still warm?

Crabtree: I can't see any difference. Here is another one. A few flakes have been removed on the outside here Cynthia. There is a slight change of texture not very much color change, but it is much easier to work. This is extremely tough. This one edge is all that has been exposed by removal of a series of small flakes.

Irwin Williams: This flake was struck off, then heat treated, and then retouched.

Crabtree: Right, just on this one edge, just to test it, and see the results. This is some petrified wood that is Indian-heated and worked, which is a good example of Indian work. Here is another piece of petrified wood showing the changes.

Joe Ben Wheat: Don, do you know who McCormick is? The guy down in S.E. Colorado who make Folsoms?

Crabtree: No.

Joe Ben Wheat: He's been making them for years and selling them around there. He works his flint hot. He takes it in an oven and heats it just in a pan in an oven till it is just hot enough that he can handle it with gloves but too hot to handle it in his bare hands and then he takes his stuff out and makes his points. He says it works almost like heating cheese, and what he uses as a fluter, you might be interested in, too, is a iron bar which comes up under the arm and it's about the length of the arm, curved like this, and the end turns out and the end comes over like this down into almost a screw driver shaped point at the end and he holds the piece to be fluted against a log, or something like that, and then he, of course, has a little tip up there and a platform and just one sharp blow like that. But the interesting thing to me is the suggestion that this is the shape of an Elk hammer.

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Crabtree: Well, that's something. That's remarkable. He supports the point against something. Well he has to support the point. I know that is one of the techniques that I hadn't used because I have broken hundreds of them till I saw the polished tips on the folsoms that Marie has at the museum.

Coe: Don, does it make any difference if the temperature fluctuates a little bit?

Crabtree: No. I think not. With the sand it wouldn't make too much difference. If it is covered with sand, it retains the heat sufficiently so it doesn't make any difference.

Coe: I was thinking of the Indian and his fire and the probability that there was some fluctuation there.

Crabtree: I don't think that it really makes any difference, if you don't heat excessively or build up the heat too fast and let the stone cool too fast. But the larger the block the more slowly the heat must be raised and the more slowly they must be cooled. I was trying to get a Folsom out of the French flint and the platform collapsed. But that has been a heat-treated piece. And this is a piece of quartzite. I can see a little change in texture but, prior to heating, it is very difficult for me to pressure flake quartzite. Yet, I know that it was done. I started examining it under glass to see the replacement of those little sand grains. If they are brecciated, the sand is a stream sand, rather than a beach sand. The beach sand quartzite has a great deal more toughness than the stream sand quartzite. If it is extremely fine, it seems like the little grains are cemented with, possibly chalcedony. You see this little matrix composed of chalcedony, if you examine the quartzite with a glass, and the finer it is, the easier it is to work. This particular piece of green quartzite is fairly coarse. There is a lot of variation in quartzites and it would require analysis to actually tell the workability of this. Quartzite is quite variable because of all the varieties of stream sands and the types of cementing and bonding agents. Here are some that are heat treated, showing different styles of work, however, they are all from the same material. Some are heated just a little differently, some are a little more lusterous, possibly. However, they are all from the same block of material. This is some more, but his was heated near the surface and the oxygen was present, however, these haven't changed color. They are all off the same piece of stone. These four. Well, that is about all that I can tell you other than I am looking forward now to getting some nice blocks of flint heating them in my deep fryer and making some of these prisms. They'll be interesting things to compare the differences in sharpness between the jasper and agates and flints with obsidian blades. I'm sure they won't be quite as sharp as obsidian but they will make some interesting tools.

Phil Smith: Is that core heated before you took those little blades off?

Crabtree: No. That core is natural. It's the natural Harrison County flint. This material here, but that was unheated.

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Tixier: It was flaked out by pressure.

Crabtree: Yes, same sort of thing.

Epstein: Pardon me, but at this stage of knowledge do you have any idea what the temporal or spacial distribution of the heat treatment is?

Crabtree: Haven't the slightest. Haven't any idea at all.

Tixier: I am sure there are some people in the Sahara which used this method, I'm sure. They treat it, they have flakes and then they retouch. It was found by Dr. Kosand from Libba and I will write Dr. Kosand and he will send you some tanged arrowheads. And only the bases, the stem is worked by pressure retouch.

Crabtree: Well, I thought when I get home I would cut some uniform size tabular slabs with a diamond saw blade. If the slabs or flakes are not uniform size it creates a variable in temperature control. I want to have a uniform tabular selection and at least carry on temperature experiments up to as far as my deep fryer will go. Then we will heat the tabular forms in different stages of temperature and then prepare thin sections and check exactly what is happening with this heat treatment. One can reserve a portion of each slab for control purposes so we can increase the heat to the breaking down point of this experiment on heating and we might know a little more about some of the materials of the quartz family minerals.

Daugherty: Don, ~~how long to send~~ some examples of that stuff up? We can check the index ~~fraction~~ refraction.

Crabtree: Oh, would you? Wonderful. I don't have any fluid or anything like that.

Daugherty: We have. We have the whole works.

Crabtree: That would be wonderful.

Daugherty: If we could get that extra little step in.

Crabtree: Oh, fine, well I'd certainly be pleased if you'd do that.

Tixier: I'll have to write to my friend about heat treatment.

Crabtree: Dr. Swanson was going to send 6 copies of the Tebiwa with his heat treatment article. A very short article. I don't know whether you got them or not.

Bordes: I may have some.

Crabtree: Oh yes. But Dr. Swanson said he would send 6 here.

Bordes: I did not receive them.

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Crabtree: I see, fine.

Bordes: I got two.

Phil Smith: Do you think that the very high solar temperatures, ~~you may select~~ in a place like the Sahara, would have any effect at all on the flakeability of the flint?

Crabtree: I don't know Yes. I suppose over a long period of time, particularly if it was a dark rock, it would absorb the heat. It, no doubt, would get up to nearly 200°F. And over a long period of time could cause this change to take place. I mean it is certainly a possibility, that it may do that. But a hundred degrees or something like that. I know some of these on the surface in our area have got to that heat and they have still stayed the same but it would have to be an intensive solar temperature in order to do that.

Phil Smith: In the Sahara you very often find pieces of flint arrow stone which does have this pot lidding on the edge. Of course, that is a high temperature - high heat.

Crabtree: I see. It might be. Well, carnelian was one of their favorite for several thousand years before the time of Christ. And carnelian doesn't come in a carnelian color, normally. I mean to find it naturally. It comes as yellow agate and has to be altered to make it into a gem stone. You don't find carnelian very often accidentally, unless there has been a forest fire or something like that that has gone over. Or maybe some underground thermal temperature that may have altered the color of the stone. Natural carnelian is a very rare stone and yet you'll find these beautiful carnelian points and also they liked it for jewelry.

Phil Smith: What color is it?

Crabtree: It's yellow and the yellow changed red. You see you can't induce hemetite into the chalcedony and it is the hemetite that makes it red. The iron salt must penetrate in a soluable form. Hemetite doesn't penetrate the stone as hemetite and this is what causes the red or carnelian color. Other mineral salts will cause the sardonyx and you'll get sard and that sort of thing. And there is a change here, I don't remember what the natural color was but I end up with sardonyx. This wood appears to be one of the forms of sard. I get Sardonyx and this sort of thing.

William Irving: Do you think that it is very difficult to make notches and points without heat treatment?

Crabtree: It's much more difficult.

Irving: Does this apply to most materials?

Crabtree: Yes. Other than obsidians. Basalts and quartzite have altered slightly but it's mainly the set group of silicious materials. Some of these very granular things of silicified clays. There is not much evidence in change of these tabular forms of that sort of silicious thing.

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Daugherty: How about things like opalized wood and things like that? Will that change?

Crabtree: Well, the opal just won't stand any heat at all. But agatized wood is very good. This is a piece of agatized wood, two pieces, in fact, of agatized wood, that the Indians have changed. I didn't change those but you see the changes have taken place.

Alan Smith: We didn't hear Bill's question over here.

Crabtree: Oh.

Irving: I wondered if notches that are used on arrowpoints are difficult to make on all materials that have not been heat treated or are somewhat more tractable than others.

Crabtree: Well, it certainly helps. I mean, it is much easier to flake and to notch heated material than it is untreated. Because the nearer it comes to obsidian or glass-like quality, which is your ideal material for flaking, the easier it is. The more glass-like the material, the better control you have. Heating, apparently, makes the granules if one can term it that, smaller. The more flexibility you have the better, because the toughness is due to the intertwining grains of these nuclei that have bound together with your quartz crystals and you must shear those in two.

William Irving: This material is related to the Norton complex. I don't know how closely related but it is fairly closely related to that. Now the Punyuk complex is closely related to the Denbigh flint complex. It has all of the diagnostics. This collection here is not fully representative but it is the best I could do on short notice. You see here some antler that has been cut by the grooving technique with these burins which you see here. We don't have any evidence of wedges used to cut the antler but there are some small polished adzes in this site which perhaps were used for this purpose. They weren't used for chopping the antler at any rate. Up above the burins, you see burin spalls. There were as many as 20 burin spalls knocked off a single burin. Some of the burin spalls were retouched at the terminal end to use as small engraving tools. Now here you see one of the most distinctive sets of implements, the very small side blades, the side hafted blades, biface with very fine parallel retouch often with serrated edges. You can tell that they were side blades because they are assymmetrical. One edge has been sharpened, the other edge is in mint, or new, condition. The edge that was held in the antler haft is in new condition. The outer edge has been resharpened many times. Small tools, such as this size, are by far in the majority in a site, such as this, however, there are some larger ones such as this bifaced implement here. This uniface whittleing knife biface knife here, and possibly a lance head. All of the large tools in this complex are end-hafted. They're stuck in sockets. Only in the later periods in Northern Alaska do we get large side-hafted blades. Microblades are very common in the site, as you can see, from this representation here. They are all made of carefully selected material which is not common in the area. It may have been carried in over a very long

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distance. Now down at the bottom of the table is material from the Norton complex, unfortunately I don't have very much of it here. It is stratigraphically later than the Denbigh flint complex and the ...P.U.N.U.K.....complex at ...P.U.N.U.K.....point. This material here, most of it came from one of two houses which was stratigraphically above the...P.U.N.U.K...,...complex. You notice that the technique of retouching in the small bifaces is very different from that on these bifaces. At least that's my impression. Also this technique appears to me to be quite different from anything represented in the large tools up above. Perhaps we could stop here and wait for comments before we go on to the next material which is much older. This material, I think, the PUNUK complex probably dates from the third millennium B.C. The Norton complex from the first millennium B.C., I believe. The other at the other end of the table is much older.

Crabtree!

~~I'm Don Crabtree and~~ I would like to have Dr. Bordes take this over. I'm not particularly familiar with burin complex it is strange to the Americas. With the flaking we might do an analysis of one of these, from the.....P.U.N.U.K.....with the Norton complex. ~~Of that sort of thing there,~~ and perhaps on this side we might do a slight analysis. We might take the most striking example and make the comparison between some of the others and this particular one, that is the type of retouch on this particular tool and the thinning and the regularity of this sort of parallel flaking. The length is much greater than the width of the flake. The overlapping starts from the edge of the artifact and the flakes carry across the face to save breaking the opposite side. You notice there is very little chattering, they feathered out with just a minimum of step fracture at this end. They did meet the other flakes on the other side. They have well controlled edges. The flakes are well spaced along the edge and the bulbs of pressure are not particularly deep. There are a few hinge fractures on this side but they have been picked up on the other side. In order to thin the tool, the pressure thinning technique was used. You might check another one on the other side. You will find this material is extremely fine-grained compared with one of the basaltic groups. Look at this type and make a mental calculation of the tip of the tools used for this pressure retouch. Evidentally they had to keep resharpening the tip of the antler pressure tool to keep it sharp.

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Crabtree: We have little short shell like fractures here with deep bulbs of pressure. But, it is unique to a pressure retouch and a serration in the same operation. This one shows more of a random technique without any regularity of flaking. They did use the same technique in their serrations in order to leave this, but it has much more pronounced bulbs of force. They moved their tool ahead, and they haven't followed the ridge in order to guide the flake with the precision they did on the other sets of tools.

Phil Smith: Could that be due to a difference in the material?

Crabtree The material is slightly more granular, however, the texture remains almost the same. It's a little different in character of workmanship than you find on the other one. They hadn't sufficient control as they had on the first bipoint that we mentioned. Part of this looks like a retouching and it ~~maybe~~ may be a resharpening operation that they used. It may have been resharpened and utilized as a knife. With the burin points and scrapers you might point out in which order you would like them analyzed. I'm just not quite sure, but some of these scars could have been from function, as the flakes are removed without a great deal ~~more~~ of precision. This scraper is interesting. Notice how they would curve the flakes over and terminate them at the edge. It's not too common with a scraper technique to have this regularity of flaking. However, this has been abraded slightly from use, but it is a well formed scraper from a single flake. Notice the point of force at this end. It's quite small without any overhang left on this side as the flake was detached. Of course it is hard to tell the original length of the flake, but it was much longer than it is now. It may have been made by resharpening a much longer flake in order to get this character. There seems to be very little pressure work on this material, however, it is a very fine grade of dark jasper. This one is another type of a flake scraper. The same sort of a

flat pressure tip on the two of them. These are identical in preparation, almost like the indirect percussion sort of thing that we were doing a few minutes ago. I mean it is quite comparable. But they have a little better platform preparation on this side without the long overlap on each side of the burin flake as this would spread and carry on through. Some of the burin flakes and microblades are quite reminiscent of the Hopwellian type of blade. In some cases they use a single ridge and sometimes they use a double ridge. You might sort out some of the proximal ends of the pressure points that are very characteristic of the Valley of Mexico. It appears there is a little polishing done on the end of this flake for a platform. But this is very distinct. Notice how they have cleared their pressure point on both sides of the platform so the flake is more easily detached. From the precision of the flaking it appears that pressure may have been used in this case. I don't know whether one could set an antler tool to this side and strike with this degree of accuracy and precision, I would lean a little toward the pressure technique rather than the percussion on this side. Because of the shock of the tool, you can't distinguish between this section of the obsidian blade and one from the Valley of Mexico. You can see the directions of the little striations on this side from the tearing of the flake from the core. But it is just a single section and we don't know what the length of that one was but it appears to be almost like the Valley of Mexico cores.

Irving: Don, access to.....(inaudible)

Also here are drawings of cores from which the microblades probably came. I don't know whether you can say anything about the drawings. I'm sorry I don't have the cores themselves here.

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Crabtree: Well, the cores are quite distinctively different from the Valley of Mexico cores and they are typical Hopwellian sort of things because these are rectangular cores, tube shaped, so they could keep following across the face of the core like the experiment we were doing on the long tabular block of obsidian with the same sort of a technique. But they are vertical with the face, apparently, rather than leading back in underneath and preparing a slant this way. These are vertically downward from this sort of thing.

Irving: There seems to be two sub-types one with the platform at a 90° angle and the other with a platform at anywhere from a 35 to 40° angle.

Crabtree: Are they all of obsidian?

Irving: No.

Crabtree: The flakes that were removed vertical from the core, would there be a difference in the types of the pressure points or platforms. Do these flakes and the jaspers indicate two different techniques?

Irving: No, I don't believe so, I think there might be a chronological difference rather than a technological one.

Crabtree: This group in here has quite.....

Irving: That is quite different.

Crabtree: I'll turn it over to Dr. Bordes now.

Bordes: Well, I have some comments to make. On difference - well, it is quite a new culture for me. This type of tools I don't know quite well. First thing have you any idea of the use of these microblades?

Irving: Not very much except that I believe that they were used in a manner similar to the small bifaces. They were probably hafted in a row in a groove along an antler arrowpoint, or perhaps a knife. In another collection very similar to this, many microblades have one edge removed by a sort of a burin blow which made one edge square. It's almost like a backed blade but not made by

retouch.

Bordes: Well, they show a little special use, anyway.

Irving: Not very much.

Bordes: They are almost fresh. Another thing about the percussion of these microblades, they are very straight. But I don't think quite possible to make them by percussion. I shall try this afternoon to show you that it can be done. And, of the cores, some are certainly cores only these, you know, look very much like some kinds of carinate scraper. Could be, you know, that they are at the same time, cores and tools.

Irwin: Could be.

Bordes: It will be interesting to see of these little retouch on the drawings are made by utilization or made on purpose.

Irving: I think there is occasionally abrasion on the obsidian cores. It doesn't show up on the cores of chert or jasper.

Bordes: But obsidian, of course, is very brittle.

Irving: Yes.

Bordes: Because if it was found in France it would be classified as a carinate scraper. But this blade, of course, you say that the part which was inside the wooden shaft - was it was fresh and the outside has been sharpened time and again.

Irving: I believe so.

Bordes: It is quite possible. Have you found such things in the shaft?

Irving: At Trail Creek, I believe they found such things and at Pewtock (ck. spl.) Panuke there which is much later. They are very common.

Bordes: Because you know that we have probably things like that in the Upper Paleolithic. Not this type but what we call lame la dau and we are pretty sure that they were. Those that we found, you know the problem which is up into the shaft and so that one question I ask.

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Irving: Many of the small bifaces are assymetrical when they are in mint condition. And those, I believe, were also hafted in the side but it's not definite in any one case.

Bordes: Another thing which is very strange are your burins. They are out of this world as far as burins go. It seems to have been a very strange way of making them. They can be burins, of course, but it looks as if they took some small flake with a kind of end fracture most of them, going there, and used that ~~in its technical form~~ as a striking platform to take off the burin blow, or else they made this kind of end by bifacial retouch before striking the burin blow which is something quite strange because it is characteristic of the Upper Paleolithic in which you find where as good a technical form as possible to take off the burin blow.

Here it is a very queer striking platform. Or perhaps they did it after. I don't have light enough! No, no, no, it was struck on this end - this ~~valuable~~ dihedral striking platform - very strange.

Irving: Excuse me, but looking at the whole collection of 175 of these burins, you find, well, there is one burin blank with no spalls knocked off. It's simply a triangular flake retouched to this shape, a trapazoidal flake. And the retouch is already there on the surface.

Bordes: Ya, ya, ya!

Irving: But they also did subsequent retouch on some of them.

Bordes: But most of them have this same preparation which is completely different. Here is one which is more right of burins. It's amusing. There has been first a burin blow like that in the longitudional line and probably after that the burin was used. They made some retouch and perhaps they took it under a burin blow. I'm not quite sure. It's difficult to tell.

It could be.

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Irving: There are many broken burins. This is the broken end of a burin, and so is this.

Bordes: Of course. But you have always this strange queer preparation. I will try tomorrow to make something like that. This is the first time I have seen something like that. As for your burin spall - yes some of them have been ~~shot~~ sharp really to make something of a small ~~bores~~ borers, ~~microbores~~ micro-borers,

Irving: These pieces of antler were cut with burins, I believe.

Bordes: Ya, it looks like. But your small burins -

Ya, ya, ya, no question. That has been done with a very. But it looks as if there were other light tools for this little work. Well, it could well be that this special preparation is another manner to make a type of blade which is fairly common in the Upper Paleolithic in France which is, I don't know how to say, or to describe it in English because a hound barrow, ~~ok. spl. w/Earl~~ or hound of point of barrow and it works like that, and that could be something. Different way to make the same to get the same results.

Ah, these are scrapers! Small scrapers!

These are nice.

And these could be Solutrean.

I can show you exactly the same in upper Solutrean.

Irving: These are so consistent in size that I think that they were made to fit almost a standarized handle.

Bordes: Ya.

And this? This one ~~this~~ is a funny Solutrean.

Ah, you say that this is a knife.

Irving: I believe so, yea. There are other examples that fall in the same category.

Bordes: Why?

Irving: The other examples have much less taken off here. They are bigger and triangular this way. I think that it was held in the handle this way and sharpened down to this little point.

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Bordes: Ya. Here is a burin blow.

Irving: Yes. For sharpening perhaps.

Bordes: Ah. I don't know. I think they missed.

Irving: Accidental?

Bordes: Either it was an accident or they tried to make a burin and they missed it. But, let me see. Oh, there is no question. There is another burin blow at the other end. They made a burin out of it - an ordinary burin.

Irving: That I think was a hafted knife, whittling knife.

Bordes: Ya. It could well be. I am not familiar with the Arctic culture. I am following up with something, that's working with flint tools. And what difference what you are working with. If it is to cut something soft well then it pays to put handle but if you want to work something hard you use more time putting the handle on flint than you would making other tools. So I wonder really if most of these things ~~we are~~ were hafted.

Irving: Many of these have lots of retouch. No they're sharpened many many times. Always on one edge not on the other edge.

Bordes: Ya, ya, ya.

Irving: Some have grinding or polishing along these basal edges which, I think, may have to do with hafting because of the end scrapers and the burins also.

Bordes: With ~~that thing it was~~ hafting or with holding, you know. The other doesn't matter, you know. I know that in Artic, the people had hafted tools and I am fairly sure that the Upper Paleolithic and then in the middle had some hafted tools. But you know, the time you spent to put the haft to a thin knife is so big compared to the time you might can really be of use that I wonder. ~~How does it~~ Another thing ~~feel~~ about the sharpening of the edge. Of course, it's sharpening in a way, but I will say that nothings cuts as well as a fresh flake without any sharpening. So if I will project the preparation of a.....Ah, what is the word.

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Irving: Make the edge stronger.

Bordes: Ya. To do it. I don't find the word.

Crabtree: Change the angle?

Bordes: No.

Irwin: Scrape?

Bordes: To go into the hide. Rather than to make it sharp and also to change the end of it because with a fresh flake you can cut meat very easily. But as soon as you work on something hard, it crushes and becomes serrated in a bad way and you can do not much with it. With this, it cuts less with the retouch. It's much less cutting. I couldn't do that you see with a fresh flake, but you can scratch or score the skin without cutting edge. And if you want to work on something hard, well, this was done with a blade, alright a blade with some reutilization. You can see by the undulations. It bites and then slips, and bites, and slips. When you want something really good really smooth you use a technique which is different and which I think was used by the Upper Paleolithic. Your work that on the side of the burin like that.

Irving: Many of these burins have that kind of use retouch. This one does.

Bordes: Let me see.

Irving: It's pretty hard to see. No. It's not here, I'm sorry.

Bordes: Not this one.

Irving: No. I'm very sorry.

Tixier: The other is burin spall.

Irving: Yes. Do you see any signs of heat treatment or can you tell?

Crabtree: Without the core, I find it difficult. I find that these are indicative of heat treatment. The other is very fine-grained. With the core one could perhaps pick up a facet of the outside of the original surface for comparison. I don't see any of the outside edges of the cores on these particular ones.

This hafted knife with the burin point or whatever, has, of course, a retouch on the outside. But it appears to be the same texture throughout. This is the entire flake but one would have to study the cores to determine whether there was any difference in texture. I hate to start an argument with Dr. Bordes about the retouched edge of this artifact, but actually, by retouching you can produce an extremely razor-sharp edge. But this example appears to have been ~~abraded~~ abraided and the flakes hinged back in by function, from scraping and these little short flakes are broken back inward and they are not full length out to the edge. But by setting the platform ahead each time, you can leave the same sharp edge by the pressure retouch. However, as Dr. Bordes said, for regular cutting, a fresh struck flake is much sharper, a fresh struck flake has more regularity, but hasn't the strength of a pressure retouched edge. By retouching properly you can still leave that razor edge. However, it won't have the regularity of the ~~originally~~ orignal flake itself. But it appears there has been heat treatment particularly with this sort of chert. That's almost opal like in texture, and it is not opal. It's one of the hard cherts or agates or ~~solicious~~ silicaous materials. I think that is all the comments I have on this particular piece other than they may have devised two methods of detaching these burins which is not likely. By percussion on obsidian you get undulations and ~~the flakes~~ these are extremely flat and extremely smooth on the side. My experience with obsidian and direct or indirect percussion has been a flake with many ripples from compression. It would be difficult to determine the placement of the tools without the core. But from these broken pieces these short flakes and the size of the platform and the very flatness of the flake on all three sides, this edge and this edge, and underneath the surface appears to be very smooth and extremely regular. This is not too characteristic of a percussion sort of blow on obsidian. With the chert and using pressure we have more strength and there is not much undulation

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in the flakes detached.

Bordes: Here are some percussion small blades.

Crabtree: Yes, You see on the edges of blade the slight compression from percussion. This one is thicker and of flint and it won't compress as much but it does have a slight compression. But ~~with~~ the heavier the dorsal ridge is on the flake, the less compression there can be. The thinner the flake, the greater the amount of undulation.

Epstein: Dr. Bordes, where are those specimens from?

Bordes: This, I made them. Just some small blades made by percussion.

Crabtree: This is quite a flat one but it is a bit thick. It's thickness eliminates the undulations. This is a little thinner one and you see a few of these waves but it's not as obvious in flint as it is in obsidian. So perhaps it could indicate maybe two methods of detaching.

Bordes: These are not the best that can be made by percussion.

Crabtree: Right, right.

Bordes: I will try to make better and see if they compare with this.

Crabtree: True.

Irving: Shall we move on to the Anagula specimens then?

Tixier: I think there were many innocent remarks made on this bladelet and also on this burin. An important thing on this burin, I think, is they were polished. It the first time I see the two techniques of polishing and then burin spalls. I never saw this even, I think, Professor ~~Hoshisaki (ck. spl.)~~ Yoshisaki show me things like this.

Irving: Possibly, possibly. I don't know of any from Japan. But it's possible that some should show up.

Bordes: No, not from Japan - from Alaska.

Irving: From Alaska more likely. But if they were from Alaska they were probably from the very same site. He has some of my specimens.

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Tixier: Something very characteristic in this burin is there, here, you see, a notch and this notch was always removed always remade before ~~even~~ every burin spall. I think this is very important. It's a very complicated technique, you see. Both these bladelets. I've rather nothing to say after Mr. Crabtree and Prof. Bordes, but I think there is one important thing. On this one, we can see the preparation of the core. You see. And I think this preparation was like some preparation - Yes. Here is. The original thing is the underform by striking the platform and the bladelets. It is very, very sharp. I never saw this but in Egyptian proto-dynastic. There are such cores or the kind of scrapers with this very very cutting edge, you see.

Epstein: Professor Tixier, how does the notching compare in regard to the burins of the Norton Complex?

Tixier: I think it's a notch.

Epstein: How well does this compare to the Noille technique? Would you?

Tixier: I think it's just the contrary. In Noille's technique the notch is made to control the end of the burin spall. Here, I think, the notch is made to have the burin spalls longer, you see. I think it's just the contrary.

Bordes: Could be. It could be, but I'm not so sure. It could be.

Irving: It could be to eliminate the jagged edge left over if the burin is to be used later for scraping.

Bordes: No. But the better thingwould be to try and make some of these burins and see how it works.

Tixier: The problem ~~program~~ is what part of this burin was used? And why polish ~~polishing~~ the two biface and dorsal face. Why, where?

Irving: Relatively soft material as compared with the other burins.

Bordes: What is this material?

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Irving: I don't know. It's a relatively soft either volcanic or sedimentary material, but it is used for not other artifacts at the site.

Bordes: And this, this polishing could be the result of working, you know. Working like that going inside the groove.

Tixier: Yes, but this one is polished all around.

Bordes: Ah, yes, but you can also use the side to cut. ~~I don't know.~~ You can do a lot of things with a burin, except kill your mother-in-law.

Byers: Isn't polishing characteristic of the burin blanks in the Arctic small tool division all the way across to the Atlantic.

Irving: Burins are very commonly polished when they show up in Sark Arc (ck. spl.) and pre-Dorset ~~technique~~ type. The same sort of polishing and often more extensive than that which shows up on these. That is sometimes almost the whole implement is covered by polishing and then the burin spalls are removed after that. Is that, does that answer your question.

Byers: That's what I had in mind. This is true in the Labradore burins too.

Irving: I believe so. Yes, and Hudson Bay and throughout the Arctic ~~Archapellago (ck. spl.)~~ archipelago and the Dorset and in Greenland. In ~~Sark Arc (ck. spl.)~~ SARQUQ and Greenland almost all the burins are polished like this.

Epstein: Bill, can one see a direction in polishing here? What I'm thinking of is, some of the materials from El Inga that Bob Bell has. He has a side scraper, concave side scraper, that shows definite striations in the direction of the edge; just straight away from the edge, and I'm wondering whether there is any direction visable in the polishing of your burins.

Irving: The striations that I have seen go in all directions. The striations go in all directions on these burins as far as I can make out and there is no complete regularity. They are at several different angles to each other.

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Epstein: Well then another question comes to mind. If possibly they are not the result of use, Mr. Crabtree, do you see any possible connection here between this polishing on the surface or what seems to be the surface and possibly the edge polishing that you've been using in working flint?

Crabtree: Well, ~~Jerry~~ Jerry, I haven't examined the burins. I left this up to the people who are familiar with burins and I am not familiar with them and I really didn't examine these. With burin technique, I have had little experience. So I'd rather not make any statement regarding that.

Epstein: Well, just an idea. I was wondering here whether you use edge grinding as a technique of strengthening the edge so that it can withstand impact.

Crabtree: Yes.

Epstein: And I'm wondering here whether this grinding which is on the surface may possible prevent, or make the burin edge that much sharper because it may possible just prevent flaking on the other side.

Irving: That's possible, Jerry, but I'll point out that some burins made of soft material, or all burins made of soft material, are polished on the faces. Almost all the burins made of chert or chalcedony, jasper, or whatever it may be, have edge grinding on most of the edges. But they don't have polishing on the faces. The edge grinding may well have something to do with preparing the platform for knocking off burin spalls, but it occurs on other edges as well so that it may have had something to do with protecting your fingers when using it or hafting the thing. The polished burins, I think, when you examine all 10 or 12 from the site, it looks as though the polishing was a way of obtaining the shape of the tool, but there are other ways to interpret.

Bordes: The best would be to experiment, and see how we can make these. Well are there questions on this material? Well lets go to the throwing ones and...

Irving: The material at the other end of the table is from the Anangula ([illegible]) wite in the Aleutian Islands excavated by Professor ~~Laitman~~ Laughlin.