

201 Highland Avenue  
Upper Montclair, N.J. 07043

October 3, 1977

Mr. Don E. Crabtree  
Box 210, Route 1  
Kimberly, Idaho 83341

Dear Don:

I just returned from a two-week trip to Germany, mostly just vacationing.

I took a trip to Institute für Urgeschichte (Prehistory) at Tübingen University, where I had a brief discussion with Prof. Müller-Beck and Dr. Joachim Hahn. I wanted to ask Müller-Beck whether he (or someone else) has done any further work on the mechanics of fracture related to flintworking since the paper by him and Kerkhof (1969). He said there hasn't really been any further work of that kind.

I may have mentioned to you that Jacques Tixier asked me at the Calgary conference why one sometimes gets fracture initiations on blades which start relatively far from the contact area. This is also the case sometimes with biface thinning flakes, etc. I view such fracture initiations as being essentially unrelated to those occurring with cone fractures. I brought up the question with Müller-Beck. He showed me some Aurignacian blades (from some German site) that appeared to have approximately the kinds of fracture initiations Tixier referred to.

I also wanted to visit Prof. Frank Kerkhof (Kerkhof and Müller-Beck 1969) at Freiburg. Kerkhof, by the way, is the director of the Institut für Festkörpermechanik (Solid Mechanics) at Freiburg. Unfortunately, Prof. Kerkhof himself was at a business trip. However, he welcomed me to visit the Institute and to meet his colleagues nevertheless. The Institute has done, and is presently doing, much pioneering-type experimental work on glass fracture. Much of their work has involved around markings on fracture surfaces.

Anyway, I met Dr. Schinker of the Institute. I showed him some unusual kinds of fractures on flakes, and within a few minutes of our discussion he suggested an experiment to measure the velocity of crack propagation by a very elegant technique they use (which was first introduced by Kerkhof, I seem to recall). Since I had my flintknapping kit with me, we tried to measure the crack velocities associated with direct percussion and punch technique. We were not successful this time, but the method can probably be used with proper planning to set up such experiments. You may have heard of this technique, which is referred to as "ultrasonic modulation." Basically, what is done here is to introduce stress waves in the "core" at a known frequency, using some laboratory apparatus. In our experiment, Dr. Schinker used a frequency of 175,000 cycles per second! Basically then, we set the core on a plate (nickel or some nickel alloy?) which was vibrating at a frequency of 175,000 cycles per second. While the core was resting on this plate (unrealistic support, I recognize) I removed a flake by direct percussion, for example. As the crack (to

Ca. 11-1-110.1

remove the flake) was moving along, the stresses at the fracture front ("ideally") were being modified at the known frequency of 175,000 cps. Such (mild) fluctuations of the stress at the crack tip should leave subtle fracture markings known as Wallner lines on the surface. (Wallner lines may sometimes look like ripples, except they are more subtle; they are viewed under an optical microscope with reflected light). Ideally, by measuring the spacing between these lines, and knowing that 1/175,000th of one second was the time lapse between any two adjacent lines, one could get the fracture velocity for various locations of the fracture surface.

What went wrong in our case was that the stress waves were not introduced in the proper way (directions, etc.), and the core geometry was too irregular for a beginning experiment. The stress waves reflected off the various surfaces of the core, etc., and consequently the surface modulations (fracture markings) on the fracture surface could not be interpreted clearly. But I will certainly try to follow up on this way of "monitoring" the fracture front and measuring its velocities.

I received a letter from Kerkhof yesterday. He noted that after the end of this year, upon his giving up the directorship of the Institute, he plans to undertake a more intensive study of fracture mechanics related to flintknapping! (He also suggested getting together some time in the future to discuss the problems).

When I was in Germany, I also made a trip to Neandertal (near Bonn and Düsseldorf) - just sentimental reasons, I suppose. The original cave has been destroyed, I was told.

With best wishes,



Are Tsirk

Ge-11-1-110-2