Curriculum VITAE

John Jeffrey Flenniken

Born: May 20, 1949; Newark, Ohio

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Education:

Henderson State College	1967-1969	
University of Arkansas	B.A.	(Anthropology)
Iowa State University	M.S.	(Expected May, 1974) (Anthropology)

Assistantships and Scholarships:

Museum Assistantship, University of Arkansas, 1969-1970
Iowa State Teaching Assistantship, 1971 -
National Science Foundation Grant to Attend Donald E. Crabtree's Flintworking School, Summer 1973

Field Research as a Student:

1968 Flenniken Site; Arkansas Archaeological Survey; Jim Scholtz; southwestern Arkansas.

1969 Bayou Sel; Arkansas Archaeological Survey; Jim Scholtz; southwestern Arkansas.

Bayou Sel; Arkansas Archaeological Survey; Dr. Frank Schambach; southwestern Arkansas.

Island Field Site; Archaeological Board of Delaware; Ron Thomas; Delaware.

Dutch Kiln Site; Archaeological Board of Delaware; Ron Thomas, Delaware.

Ellis Pugh Site; Arkansas Archaeological Survey; Dr. Martha Rollingson; southeastern Arkansas.

Lake Port Site; Arkansas Archaeological Survey; Dr. Martha Rollingson; southeastern Arkansas.

Testing Sites on Bayou Bartholomew; Arkansas Archaeological Survey; Dr. Martha Rollingson; southeastern Arkansas.

Zebree Site; Arkansas Archaeological Survey; Dr. Dan Morse, northeastern Arkansas.

Field Research as a Student (Con't):

1970 Field School; Poe Site; University of Arkansas Museum; Dr. M.P. Hoffman; western Arkansas.

Salt Peter Cave; Arkansas Archaeological Survey; Ken Cole, northwestern Arkansas.

Falling Water Falls Shelter; Arkansas Archaeological Survey; Ken Cole; northwestern Arkansas.

Blue Spring Site; Arkansas Archaeological Survey; Dr. R.G. Chenhall; northwestern Arkansas.

1971 Blue Spring Site; Arkansas Archaeological Survey; Dr. R.G. Chenhall; northwestern Arkansas.

Hayes Mound Site; Arkansas Archaeological Survey; Dr. J.C. Weber; southwestern Arkansas.

Field Research as an Assistant Supervisor:

1971 Indian Rock House of Panther Cave Shelter; Field Assistant; Arkansas Archaeological Survey; north central Arkansas.

Field Research as a Supervisor:

1971 Relocation of M.R. Harrington's Sites on Ozan Creek; Arkansas Archaeological Survey; southwestern Arkansas.

Relocation of C.B. Moore's Sites on the Ouachita River; Arkansas Archaeological Survey; southwestern Arkansas.

Testing Certain C.B. Moore Sites; Arkansas Archaeological Survey; southwestern Arkansas.

Archaeological Survey of Cherry Creek; Arkansas Archaeological Survey; northwestern Arkansas.

Archaeological Survey of Richland Creek; Arkansas Archaeological Survey; northwestern Arkansas.

1972 Consultant on Analysis of Lithic Materials from the Skunk Reservoir; Iowa State University; Dr. David M. Gradwohl.

Supervisor of Iowa State University Field School in eastern Kansas:

Archaeological survey of three creeks.
Excavation at 14JO46.

13BN110; Iowa State University; Field Supervisor; central Iowa.

1973 13BN110; Iowa State University; Field Supervisor; central Iowa.

Teaching Experience -- Iowa State University:

I have been a teaching assistant for the following courses:

Introduction to General Anthropology
(five discussion classes)

Teaching Experience -- Iowa State University (Con't):

Introduction to Physical Anthropology
(Including human osteology laboratory)

Introduction to Archaeology
(Including archaeology laboratory, i.e. methodology, field techniques, lithic technology, flintknapping)

Archaeological Laboratory Technician:

Arkansas Archaeological Survey 1970 - 1971

Papers Presented:

Flenniken, J.J.
A Suggested Functional Classification of Aboriginal Abraders. Presented at Plains Anthropological Conference, Annual Meeting, Lincoln, Nebraska, November, 1972.

Flenniken, J.J.
The Making of a Clovis Point. Presented at Iowa Archaeological Society Conference, Annual Meeting, Mt. Ayr, Iowa, 1973.

Mandeville, M. and J.J. Flenniken
A Comparison of Flaking Qualities of Nehawka Chert Before and After Thermal Pretreatment. Presented at Society for American Archaeologists, Annual Meeting, Miami, Florida, May, 1972. Presented at Plains Anthropological Conference, Annual Meeting, Lincoln, Nebraska, November, 1972.

In Press:

Mandeville, M. and J.J. Flenniken
A Comparison of Flaking Qualities of Nehawka Chert Before and After Thermal Pretreatment. Plains Anthropologist. (In Press)

In Preparation:

Faunal Analysis of Strickland Island.

Earliest Inception and Distribution of Side-Notched Projectile Points in the Southeast United States.

Cultural Change Demonstrated by Projectile Points.

Replication Studies in Lithic Technology.

Thermal Pretreatment of Novaculite.

Flintknapping Demonstrations:

Iowa Archaeological Society Conference, Annual Meeting, Ft. Dodge, Iowa, April, 1972.

Lithic Workshop, Plains Anthropological Conference, Annual Meeting, Lincoln, Nebraska, 1972.

Special Archaeological Skills:

Flintknapping
Lithic Analysis
Salvage Archaeology: Mapping
Surveying

PROPOSED INVESTIGATIONS INTO
THE MECHANICAL PRINCIPLES OF STONE TOOL MANUFACTURE

Submitted as a doctoral research proposal by Alaric Faulkner

to the

Department of Anthropology, Washington State University

Desired starting date: June 1, 1970

Duration of research: one year

Alaric Faulkner
March 17, 1970

Dissertation topic

The Mechanics of Stone Tool Manufacture

Subject matter

The ~~domain of the~~ proposed investigation ~~includes~~ consists of physical examination and experimental reproduction using suitable models of fractures produced in making chipped stone implements. More precisely, it covers the regular conchoidal fracture of a selection of isotropic, brittle materials known to vary in ~~knapping~~ properties critical to their use in flint knapping.

Background

Flaked stone artifacts are generally well-preserved, being more resistant to ~~most~~ weathering agents than most non-lithic artifacts. Because prehistoric man often relied on the sharp edges which can be produced in the brittle fracture of certain lithic materials, and because these materials are available in many parts of the world, stone artifacts are widely distributed in time and space. Although durable from the standpoint of preservation, these tools were repeatedly broken, exhausted, or misplaced in the course of everyday life, necessitating frequent replacement. Consequently, the archaeologist is often provided with a large, well-preserved sample of stone tools and related debris in a particular site.

Recently, many archaeologists have become aware of the value of attempting to duplicate lithic specimens experimentally using primitive techniques, in order to make better use of this vast amount of lithic data. Under the ~~tutelage~~ direction of such lithic experts as François Bordes at Bordeaux ~~(Sorbonne)~~ and Donald Crabtree at Idaho State University, Pocatello, archaeologists and students have learned how to produce a variety of tools using both percussion and pressure techniques. In fact, Idaho State University and Washington S~~a~~tate University both offer courses in this subject. In pursuing lithic technology imitatively the investigator gains a "feeling" for a particular technique used on a particular material, for in order to achieve success he must overcome technical problems by making decisions similar to the decisions made by the successful native flint knapper. This is not to say that in duplicating an artifact one automatically duplicates the manufacturing techniques employed by the primitive; nevertheless one is better equipped to distinguish the technological aspects of a tool from its formal and functional aspects. Consequently, one is able to distinguish tool types according to more "meaningful" criteria.

Purpose and significance of the proposed investigation

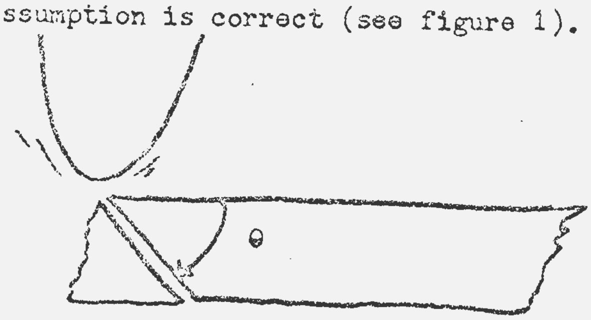
The purpose of this investigation is to go beyond the consideration of flint knapping from the native point of view. The archaeologist usually works from the reverse aspect, using the wreckage of stone tool making to reconstruct the circumstances which produced it. For this purpose he needs more than a working knowledge of stone tool manufacture; he needs to know reliably and quantitatively the interrelationships between factors involved in the controlled fracture of stone in order to establish the boundary conditions within which a given fracture must have occurred. A native craftsman does not need to formalize the interaction between such factors as internal friction, confining pressure, and the axis of maximum shear in order to remove a flake from a core at a specific angle; occasional error automatically acts to reinforce the appropriate behavior. Yet the archaeologist can make use of these concepts to reconstruct reliably, if only in part, the context in which the flake was removed. The significance of this information lies in its potential contribution to inferences about past behavioral patterns, technological sophistocation, human physiology.

The purpose of this investigation, then, shall be to produce a theory of controlled brittle fracture, i.e. a theory of flint knapping.

Procedure

Four materials are tentatively suggested for comparative purposes. A fine-grained basalt would be chosen because of its marked resistance to fracture (often loosely described as "hardness") in comparison to many other materials suitable for making stone tools. Chert, my second choice, might be described by a flint knapper as "more brittle", for in certain forms it seems to fracture with less effort; for this reason it has always been a popular material when available. Obsidian, also a popular material, fractures with even less effort, and because of its availability in quantity it would also be a likely choice. Finally, a silica glass, which has long been a model material in fracture mechanics, would be helpful as a control to aid in applying other brittle fracture studies to the subject of flint knapping.

One of the first tests to be made on the rock samples will be the determination of the angle of internal friction of each material. This parameter is of importance in establishing whether or not the materials can be expected to obey the Coulomb-Navier and Mohr theories of brittle fracture (Anderson, 1957 and Obert and Duvall, 1967). For example, a thin slice of obsidian, when struck from above should fracture at an angle of 45° plus one half the angle of internal friction (ϕ) if the above assumption is correct (see figure 1).



$\theta = 45° + \frac{\phi}{2}$ where ϕ is the angle of internal friction.

The method used to calculate the angle of internal friction involves the use of a triaxial vessel, a device used to test the compressive strength of a sample under variable conditions of confining stress. The details of this calculation may be found in Obert and Duvall (1967: 284). Procedurally, it requires the preparation of ten to twenty cylindrical cores of each material. The cores, 2 inches in diameter, and 4 inches high, are made with a diamond tipped coring machine, and the ends of each core are ground square with its longitudinal axis to insure uniform compression of the sample. Waste material is considerable, and large samples of each rock type are required. Furthermore, an attempt will be made to heat treat the materials as well, using a kiln, to see what effect this may have on the angle of internal friction of the material.

Once a relationship has been established between the direction of the applied force and the initial direction of fracture, we can make use of the technique of three-dimensional photoelasticity to determine the stress distribution within an artifact which is being flaked. A complete description of this method may be found in Dally and Riley (1965) or any number of texts covering experimental stress analysis. Using this technique, an investigator must cast a model of the tool to be analyzed in epoxy resin, a process taking about two weeks of curing time in a specially designed oven to avoid causing any thermal stresses in the casting. This casting may then be loaded in simulation of a striking force, heated to a critical temperature, and then cooled, in this way actually "freezing" stresses into the plastic. Finally the casting may be sectioned in any plane in slices of uniform thickness, and these sections, the stress pattern still frozen in them, may then be examined in polarized light. The property of "birefringence" or "double refraction", the ability to split incident polarized light into a fast component and a slow component, is imparted to the stressed plastic. When viewed through a polarizing filter this phenomenon produces patterns which allow us to determine the distribution of stress within the plastic. Knowing the direction of fracture relative to the principle stress axes and the distribution of stress within a particular form, it should be possible to predict the path of the fracture.

Dynamic tests, relevant to percussion flaking, have been carried out in glass using high speed photography. Schardin (1957), for example, discovered that cracks in glass start slowly, but soon reach an absolutely constant velocity of propogation, a property determined by the chemical composition of the glass. Coupling this knowledge with what is known about the propogation of elastic waves in glass, it may be possible to explain such features as ripple marks and hackle lines (striae occurring along the axis of the bulb of percussion) and make use of these landmarks diagnostically. Procedure would include the measurement of fracture velocities in each of the four test materials.

Finally, repeatable dynamic tests would be set up in simulation of percussion flaking. Factors to be investigated are those known qualitatively to affect lithic fracture: size, mass, shape, hardness, and velocity of the hammerstone or billet, the nature of the striking platform, the direction of contact, the nature of support of the material, the confining pressure contributed by the grip of the hand, and so on. Again, large amounts of raw materials are required. It is possible, moreover, that the technique of photoelasticity may be adaptable to dynamic stress analysis of percussion flaking.

Intended outcome

This investigation represents the first rigorous attempt to develop a theory of rock fracture applicable to flint knapping. Although it can not be expected to be exhaustive, it may provide a workable scientific tool for archaeologists to extract new information from collections. Hopefully it will raise new, significant questions and spur deeper investigation into this subject.

Facilities available to the investigator

Triaxial stress equipment will be available to the investigator through courtesy of the College of Mines, University of Idaho. Photoelastic equipment for stress freezing is available in the Department of Mechanical Engineering in that same institution. The facilities of the Laboratory of Anthropology, particularly the shop, shall be used in preparation of dynamic testing equipment. It is expected that other relevant equipment, such as highspeed motion picture apparatus, shall be used as it becomes available, and arrangements have been made . . .