copy for MASCA

Budget Entries
School _____ Dept. Museum

Page 1 of 1

Budget Period 7/1/26 through 6/30/27

Title of Account NSF-SOC-75-04203

Approved by _____

Original Budget and Update of Original ☐ (Col. 10-11 = "20")
Running Budget Update (Positive Numbers Only) ☒ (" " " = "21")
attach justification for changes

Revenue					
52781511	0		A-1 NON ACADEM RES	252400	A-1 2524
	150		A-3 echnical	231200	A-3 2312
	161		A-4 Tim CLRD	80300	A-4 803
	191		A-1 Emp Benefits 12 2%	30800	
	193		A-3/4 Emp BEN 15%	46700	EB 775 tdal 6414
	200		DOMESTIC TRAVEL	188300	
	205		FOREIGN TRAVEL	13600	
	213		RESEARCH SUPPLIES	90000	
	235		SPECIAL SERVICES	85300	
	242		EQUIP RENTAL	80800	
	248		AIRCRAFT RENTAL	68800	CE. (5268
	860		EQUIPMENT	114600	Equip (114600
				00	

To transfer from Current Expense to Salaries per NSF approval on file at Research Admin.

NATIONAL SCIENCE FOUNDATION

MAR 3 1975

PROJECT SUMMARY

NSF GRANT NO.
SOC75-04203

NAME OF INSTITUTION (NSF DIRECTORY NAME)	ADDRESS OF INSTITUTION (INCLUDE BRANCH/CAMPUS & COMPONENT)
University of Pennsylvania	Philadelphia, Pennsylvania 19104
PRINCIPAL INVESTIGATOR SOCIAL SECURITY NO. Froelich Rainey	DIVISION (OFFICE) AND DIRECTORATE SECTION ~~Social Sciences/Research~~
PROPOSAL NUMBER ~~SOC7504203~~	PROGRAM Special Projects

TITLE OF PROJECT

Applied Science Center for Archaeology

SUMMARY OF PROPOSED WORK (LIMIT TO 22 PICA OR 18 ELITE TYPEWRITTEN LINES)

Funds are provided to assist the research operations of the University of Pennsylvania's Applied Science Center for Archaeology. The Center is principally concerned with those developments in nuclear physics, chemistry, electronics, remote sensing, and other fields which are now producing fundamental changes in scientific technology. Advances in modern archaeological and anthropological research draw upon adaptations growing out of these developments, and the Center performs a unique function in the United States by researching and producing technical applications based upon new principles and discoveries. Such applications now make it increasingly possible to think of the time when we will have put together a precise record of the whole history of man on earth.

By strengthening the Center's supporting staff and providing additions to its existing equipment, grant funds will permit the developmental research undertaken at this facility to remain current in a period of rapid technological change, and to impact the disciplines of archaeology and anthropology on a nation-wide scale.

DURATION GRANTED	AMOUNT GRANTED
~~24~~ months	$175,000

A copy of this summary has been sent to the Science Information Exchange at the Smithsonian Institution for reference and public records.

NSF Form 4, Jan. 1970

5. PRINCIPAL INVESTIGATOR

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

RESEARCH GRANT BUDGET & FISCAL REPORT

Form Approved
Budget Bureau No. 99-R0013

Please read instructions on reverse side carefully before completing this form.

INSTITUTION AND ADDRESS	NSF PROGRAM	GRANT PERIOD
University of Pennsylvania Philadelphia, PA	Special Projects	*from* 3/15/75 *to* 8/31/77
		REPORTING PERIOD *from* *to*

GRANT NUMBER	BUDGET DUR. (MOS.)	PRINCIPAL INVESTIGATOR(S)	GRANTEE ACCOUNT NUMBER
SOC75-04203	24	Rainey	

	NSF Funded Man Months Cal.	Acad.	Summ.	NSF AWARD BUDGET	CUMULATIVE GRANT EXPENDITURES *Do Not Round*
A. SALARIES AND WAGES					
1. Senior Personnel					
a. (Co)Principal Investigator(s)				$	
b. Faculty Associates					
Sub-Total				$	$
2. Other Personnel (Non-Faculty)					
a. 1 Research Associates—Postdoctoral	4			4,840	
b. 1 Non-Faculty Professionals	12			14,300	
c. 3 Graduate Students				28,800	
d. Pre-Baccalaureate Students					
e. 2 Secretarial—Clerical				27,810	
f. Technical, Shop, and Other					
TOTAL SALARIES AND WAGES				$ 75,750	$
B. STAFF BENEFITS IF CHARGED AS DIRECT COST				13,337	
C. TOTAL SALARIES, WAGES, AND STAFF BENEFITS (A + B)				$ 89,087	$
D. PERMANENT EQUIPMENT *					
As listed in the revised proposal budget				12,167	
E. EXPENDABLE EQUIPMENT AND SUPPLIES				6,350	
F. TRAVEL 1. DOMESTIC (INCLUDING CANADA)				4,000	
2. FOREIGN **				5,000	
G. PUBLICATION COSTS				4,000	
H. COMPUTER COSTS IF CHARGED AS DIRECT COST					
I. OTHER DIRECT COSTS					
Equipment Rental - $4,000 Machine Shop Services - $250				4,250	
J. TOTAL DIRECT COSTS (C through I)				$ 124,854	$
K. INDIRECT COSTS					
44.5% of Modified Total Direct Costs				50,146	
L. TOTAL COSTS (J plus K)				$ 175,000	$
M. AMOUNT OF THIS AWARD (ROUNDED)				$ 175,000	
N. CUMULATIVE GRANT AMOUNT				$	
O. UNEXPENDED BALANCE (N. BUDGET MINUS L. EXPENDITURE)					$

REMARKS: Use extra sheet if necessary

* Excluded from indirect cost base.
** As listed in revised proposal budget

FOR NSF USE ONLY
Final Fiscal Report Accepted
Grant Closed_____ Remains Open_____
By_____ Date_____
Grants Administration Section, Area_____

SIGNATURE OF PRINCIPAL INVESTIGATOR	TYPED OR PRINTED NAME	DATE

I CERTIFY THAT ALL EXPENDITURES REPORTED ARE FOR APPROPRIATE PURPOSES AND IN ACCORDANCE WITH THE AGREEMENTS SET FORTH IN THE APPLICATION AND AWARD DOCUMENTS

SIGNATURE OF AUTHORIZED OFFICIAL	TYPED OR PRINTED NAME & TITLE	DATE

FOR NSF USE ONLY

Organ. Code	F.Y.	Fund ID	Prog. Code	Ob. Class	O/Dres.	Award No.	Amd.	Inst. Code	Unexpended Balance	Trans.	Lot
									$		

NSF Form 98, JULY 1971

SUPERSEDES ALL PREVIOUS EDITIONS

UNIVERSITY of PENNSYLVANIA

OFFICE OF RESEARCH ADMINISTRATION

DIGEST OF TERMS OF GRANT FROM NATIONAL SCIENCE FOUNDATION

GRANT NO. SOC75-04203

PRINCIPAL INVESTIGATOR Dr. F. Rainey

ACCOUNT NUMBER 5-27815

DEPARTMENT University Museum

TITLE Applied Science Center for Archaeology

AMOUNT OF AWARD $ 175,000

INDIRECT COST 44.5% NTDC - $50,146

Budget period from 3/15/75 to 8/31/77. Future Commitment -- yrs.

DIGEST OF TERMS FOR: New Award [X] Continuation Award [ ] Supplement Award [ ] Research [X]
Training [ ] Other ____. Original Digest [X] Revision of digest dated ____
Change of dates only [ ]

REPORT DATES: Financial 11/30/77. Scientific Annual & Final.

COST SHARING: A contribution of $ 65,531 from non-federal sources will be made to this project as provided in the cost-sharing statement presented with the proposal for this grant.

BUDGET: Employee benefits should be budgeted as follows: A-1 12.2% 17.7% A-2 20.5% 24.6% A-3/4 15% to 6/30/75 23.4% @ 7/1/75

DOMESTIC TRAVEL: To be authorized by Dr. Rainey if included in grant award. Reimbursement claims for Travel Costs must be fully documented unless at an established per diem rate. Travel by private automobile reimbursed at 12¢ per mile.

REBUDGETING OF FUNDS: Prior approval must be obtained from NSF for rebudgeting funds for the following purposes (1) Purchase of office equipment, furniture, air conditioners and motor vehicles. (2) Purchase of equipment in excess of 125% of the total amount approved by NSF for permanent equipment. (3) Purchase of any item of equipment costing $1000 or more (if not in approved budget). (4) Foreign travel when not listed in the proposal. (5) Domestic travel in excess of 125% of approved budget or $500 whichever is greater, if funds not budgeted for travel up to $500 may be expended. (6) Salary of Principal Investigator or other senior personnel in excess of that provided in the approved budget.

PUBLICATIONS: Copyrighted material shall carry by-line acknowledging sponsor's support and shall grant to the Government royalty-free right to reproduction. Four (4) reprints of each publication to be forwarded to the sponsor.

PATENTS: Any patentable invention or discovery shall be reported to the National Science Foundation.

PROPERTY: Title to property purchased with grant funds rests with the University.

OTHER:

DISTRIBUTION:
Principal Investigator Dr. Rainey w/cy grant award.
Comptroller, Attention: Mr. Campbell w/cy grant award.
~~Dean:~~
Business Administrator Mrs. Swift
File
Dr. E. K. Ralph ✓

AM/imm 3/13/75

~~DEAN~~

MAY 17, 1973

UNIVERSITY OF PENNSYLVANIA
Office of Research Administration
PROPOSAL TRANSMITTAL AND APPROVAL FORM

PRINCIPAL INVESTIGATOR(S)	DATE
Martin Biddle	Nov. 29,1977

POSITION/TITLE	TEL. NO.	SOC. SEC. NO.
Director of University Museum and Professor of Anthropology	(215) 386-7400	241-80-1725

DEPARTMENT	SCHOOL
University Museum	

TYPE OF PROJECT
☒ RESEARCH ☐ TRAINING ☐ OTHER (Specify) _____

TITLE OF PROJECT
Museum Applied Science Center for Archaeology (MASCA)

☐ NEW PROJECT ☐ SUPPLEMENTAL ☒ RENEWAL
☐ NON-COMPETING CONTINUATION ☐ REVISION

SPONSOR	IDENT. NO. (If Any)
National Science Foundation	

FUNDS REQUESTED	INDIRECT COST RATE	PROPOSED START DATE	DURATION
$258,205	52.5% & 54.0%	July 1, 1978	2 years

IDENTIFY SPACE AND FACILITIES TO BE USED FOR PROJECT: (Bldg., Room, Type, etc.)

University Museum, rooms 180, 181, 182, 183, 184, 185, 186, and 188

SPECIAL INSTRUCTIONS: (Mailing, Deadline Date, etc.)

University Museum, 33rd and Spruce Streets, Philadelphia, Pa. 19104.

OTHER APPROVAL INFORMATION (Check Each of the Following)

1. ☐ Yes ☒ No — Does the project involve human subjects? If YES, fill out Part I on reverse side.
2. ☐ Yes ☒ No — Will additional space, facilities or renovations be required now or in the future? If YES, fill out Part II on reverse side.
3. ☒ Yes ☐ No — Is additional equipment required for project? If YES, identify source of funds NSF. If major equipment installation is required, fill out Part II on reverse side.
4. ☒ Yes ☐ No — Does the project involve participation by personnel from other Departments or Responsibility Centers? If YES, fill out Part III on reverse side.
5. ☐ Yes ☒ No — Does the project involve the use of animals? If YES, project must be reviewed in accordance with Animal Care Policy dated 1/31/75. (Contact DLAM on extension 6468 for further information.)
6. ☒ Yes ☐ No — Does the project involve the use of radioactive materials or radiation-producing machines? If YES, consult the Radiation Safety Office on extension 7187.
7. ☒ Yes ☐ No — Will any portion of the research or training be conducted Off-Campus?
8. ☐ Yes ☒ No — For proposals to other than HEW, is Cost Sharing required? If YES, specify the source and amount of funds
9. ☐ Yes ☒ No — Are Subcontracts included in this project proposal? If YES, identify proposed subcontractors and amount of support proposed.
10. ☐ Yes ☒ No — Does project involve in vitro formation of a recombinant DNA capable of replicating in a host cell? If "Yes", project must be reviewed by the Biohazards Committee.

APPROVAL CERTIFICATIONS

1. PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: I certify that the above information is accurate and complete as of this date. I agree to accept responsibility for scientific and technical conduct of the project and for provision of required technical reports if a grant or contract is awarded as a result of this application.

Martin Biddle
(Signature Principal Investigator/Project Director) (Date)

2. DEPARTMENT CHAIRMAN: The attached application (proposal) is approved. It is within the total program and academic objectives of the Department. Adequate space is available or planned for the conduct of the project. The professional time allocations described therein are realistic. The use of human subjects is approved as applicable.

(Signature of the Department Chairman) (Date)

3. DEAN OF SCHOOL: The proposed project is approved. It is consistent with the total program objectives of this school and the commitments to this project are acceptable.

(Signature of Dean) (Date)

COMMENTS:

NOTE: This form is not sent to sponsors with proposal. The title or cover page of the proposal itself should allow for signatures of the Principal Investigator(s) and the authorizing offical of the University.

RA-001 3-76 (Rev. 1/77)

PROPOSAL TRANSMITTAL AND APPROVAL FORM

PART I HUMAN SUBJECT INFORMATION – Refer to University of Pennsylvania Policies and Procedures entitled "Human Subjects in Research" issued by Research Administration in 1974.

NOTE: The University Committee on Studies Involving Human Beings requires 15 copies of the project protocol and consent form for its review process. Provide these to the Office of Research Administration Committee Coordinator (Tel. Ext. 7293) for distribution. If the protocol exceeds 4 pages in length, summarize the procedures, risks and benefits to be expected, and specify the measures to be taken to protect the subjects involved.

PLEASE ANSWER THE FOLLOWING QUESTIONS:

1. ☐ YES ☒ NO Does the project involve the administration of personality tests, inventories, or questionnaires? If YES, provide the name of the tests, if standard, or a complete copy if not standard.

2. ☐ YES ☒ NO Does the project involve exposure of subjects to radiation? if YES, consult the Radiation Safety Committee Office Ext. 7187

3. ☐ YES ☒ NO Does the project involve testing experimental drugs? If YES, provide the IND Number, name of manufacturer, and information on acute and chronic toxicity, side effects, and pharmacological actions. Provide one copy of the sponsor's drug brochure.

☐ YES ☒ NO Do the proposed studies involve the use of electrical apparatus other than routine patient care equipment at the Hospital of the University of Pennsylvania?

NOTE: If the project was ever previously reviewed by the Committee on Studies Involving Human Beings, give the review date: _____ and answer questions 4 and 5.

4. ☐ YES ☒ NO Have you changed the project in even the slightest manner since the last approval? If YES, furnish complete information on changes.

5. ☐ YES ☒ NO Has any subject suffered complications or needed further treatment because of participation in the project? If YES, give the details and describe actions taken to eliminate any recurrence.

DEPARTMENT CHAIRMAN: Signature on Sheet I confirms the above information, signifies familiarity with the proposed project and approves the use of human subjects. If the Department Chairman is the Principal Investigator, the project should be reivewed and approved by a senior professor in the Department who may sign in the following space

_____

PART II. SPACE, FACILITIES, RENOVATIONS OR EQUIPMENT INSTALLATION REQUIREMENTS:

NOTE: These requirements must be approved by the Vice President for Operational Services PRIOR to the submission of the proposal to the sponsors.

1. Briefly describe requirements for new space, facilities, renovations or major equipment installations; (Items in addition to that specified on Sheet I). Specify locations.

2. ESTIMATED COSTS:	ESTIMATES MADE BY:

_____ _____

ate (Signature Vice President for Operational Services)

3. Are the space and other requirements described above, and the space presently assigned adequate for future requirements of this project?

☐ YES ☐ NO

PART III. INTERDEPARTMENTAL OR INTERSCHOOL PARTICIPATION

1. Participation in the proposed project by personnel of my Department or School is approved:

A. Department	B. Department
Chairman's Signature	Chairman's Signature
School	School
Dean's Signature	Dean's Signature

■ Correspondence with individuals interested in a newsletter on Gypsies. Write: Rena C. Gropper, 99–40 63 Road, Rego Park, N.Y. 11374, U.S.A.

■ Photographic material of interest to ethnologists, archaeologists, art historians, and historians on Polynesia (especially the Maori), Micronesia, and Melanesia, for an archive now being assembled by the Department of Anthropology of the University of Auckland, New Zealand. (So far the archive includes 19,000 items.) Photographs must be dated, and all relevant information on the event or artifact shown must be recorded. Donors will be acknowledged and copyright safeguarded if the donor so desires. Send materials and requests for further information to: Sidney Moko Mead, Department of Anthropology, University of Auckland, Auckland, New Zealand.

Institutions

■ The ANTHROPOLOGY FILM CENTER, Santa Fe, New Mexico, U.S.A., was established in 1966 to facilitate training, research, and communication among anthropologists utilizing film. The facilities of this nonprofit organization include a library and space for research work. C. Warner Williams directs consultation services and a training program in anthropological film.

The Center is committed to the study of problems of film recording and communication and of techniques and methodologies that will more fully utilize the qualities of the medium for anthropological work. Educational film with anthropological content is included in the Center's area of study.

For further information, write Anthropology Film Center, P.O. Box 493, Santa Fe, New Mexico 87501, U.S.A.

■ The CENTRO DE INVESTIGACIONES DE SELVA of the Instituto Raúl Porras Barrenechea, Escuela de Altos Estudios y de Investigaciones Peruanistas, Universidad Nacional Mayor de San Marcos, Lima, Peru has as its objectives the following:

1. To compile and edit the scattered writings of Raúl Porras in the field of Amazonian studies and to organize the data gathered by him over many years of study.

2. To promote anthropological studies of the jungle peoples, especially those of the Peruvian Amazon, which may serve both as a contribution to scientific knowledge and as a basis for programs of development among these peoples.

3. To act as an information center for researchers and research institutions concerned with this area, both Peruvian and foreign.

4. To assist in the organization of such discussions, courses, and conferences among researchers as might add to scientific knowledge of the area and foster understanding of its peoples among the general public.

5. To serve as consultant on these matters and a defender of the jungle peoples.

6. To encourage the setting up of archives of photographs, sound recordings, and other ethnographic materials on the traditional cultures of the jungle before they have been altered or destroyed.

Correspondence may be directed to Stefano Varese, Director, Centro de Investigaciones de Selva, Instituto Raúl Porras Barrenechea, Colina 368/398, Miraflores, Lima, Peru.

■ The DOCUMENTATION AND INFORMATION CENTRE of the Polish Ethnological Society was established in May, 1968 at the Department of Ethnography of the University of Łodz, Poland, under the direction of Kazimiera Zawistowicz-Adamska. The Centre gathers information on research activities in Poland and elsewhere and maintains files on the contents of archives and the collections of museums and other ethnological institutions. It has produced so far a list of Polish dissertations in ethnology 1945–68, a directory of Polish and foreign research institutions, and a directory of Polish ethnographers. Future projects are to include a documentation of folk culture and folklore and a central ethnographic archive.

■ The DÜSSELDORFER INSTITUT FÜR AMERIKANISCHE VÖLKERKUNDE (Düsseldorf Institute of American Ethnology) was founded in 1930 by Willi Michel, who is now Honorary Collaborator of the Institute. Its director is Helmut Krumbach; Horst Matthey is in charge of the archives. The Institute gathers literature on the aborigines of the American continent and on the natural-scientific and national-geographic aspects of the Americas. It produces reports in this field, for example, an extensive work in German on the German-American painter of American Indians, Charles Wimar (1828–62). It organizes exhibitions: "Hobby—Amerikanische Völkerkunde" (Hobby—American Ethnology) in January, 1960; "Peru und die Hilfe deutscher Ärzte" (Peru and the Aid of German Physicians) in January, 1965: and "Mittelamerikanische Bilderhandschriften" (Central American Codices), scheduled for 1970. It arranges symposia and keeps in touch with researchers. Since June, 1968, the Institute has co-operated with the University of Düsseldorf, where its archives are placed. It also publishes a journal, *Ethnologia Americana*, which appears six times a year and contains book reviews and articles on ethnological themes.

For information, write the Institute at Merowingerstrasse 12, 4 Düsseldorf 1, Germany.

■ THE MUSEUM APPLIED SCIENCE CENTER FOR ARCHAEOLOGY of the University Museum, Philadelphia, Pa., U.S.A., was initiated in 1961 by Froelich Rainey. Its aim is to apply new principles and technologies developed in the physical sciences to archaeological and anthropological research. The successful application to archaeology of carbon-14 dating, in the laboratory here (established in 1951) and in others, suggested the possibility that many other technological advances might have applications in this field. The investigation of this possibility began with work on thermoluminescence dating of pottery and on the development and use of instruments for archaeological prospecting. An information center and a newsletter were established. Since then, the existing chemistry laboratory has been expanded to include a much more active program of conservation and restoration. Also, work in dendrochronology is being pursued to provide samples of known age for C^{14} dating.

Research on the possibility of using thermoluminescence for dating pottery was started here in 1959 and has been pursued actively since 1962. Significant progress made during the past two years indicates that the method will be a reliable one, possibly as good as C^{14} dating or better. It has the advantage that it dates the artifact itself (a few milligrams of pottery) rather than a charcoal or other carbon sample that is merely (and sometimes erroneously) associated with the occupation level to be dated. The method is based on the fact that particles from traces of radioactive elements in clays bombard the other constituents and raise electrons to metastable levels. When the clay is heated, enough extra energy is supplied to enable the electrons to return to normal states. In this transition each one

emits a photon of light. The final heating of a ceramic is, therefore, the starting point of the metastable electron accumulation. In the laboratory, a few milligrams are ground, mounted, and heated very rapidly so that as much of the light output as possible is detected before the onset of heat radiation. The light output is detected by a photomultiplier tube, amplified, and recorded against the temperature on an X-Y recorder. The rate of radioactive bombardment is also measured. The variations among clays in susceptibility to radiation damage is corrected for by artificial bombardment with X-rays and subsequent remeasurement of the glow curve.

The work of MASCA on the development of instruments for archaeological prospecting was undertaken in the light of the great need for the acceleration of the finding of sites and for the delineation of structures within sites already found. The destruction of many sites is imminent, due to the rapid encroachment of modern civilization. Also, with the cost of labor increasing all over the world, it is becoming impractical to excavate unless there is a certainty that structures or levels of habitation will be found. MASCA has tested a number of instruments that have seemed suitable for archaeological exploration. These include the Elsec proton magnetometer, the Gossen Geohm, and various metal detectors and seismographs. In the course of the search for the ancient Greek city of Sybaris, buried at depths of 4–6 m., it was found that proton magnetometers were not sufficiently sensitive for the detection of structures or archaeological deposits at these depths. At MASCA's request, the engineering firm Varian Associates designed and developed a more sensitive portable cesium magnetometer, with digital readout and differential mode of operation. This has now been tested in two field seasons and has proved to be the ideal instrument for archaeological prospecting in regions that are normally magnetically quiet and where the features sought present some contrast in magnetism. Again, it was found that the wavelengths of standard seismographs were too long to be used in finding archaeological features, usually located above much more massive geological ones. Experiments directed toward the development of a sonic instrument have produced much information about the problems involved, but a successful portable design has not yet been achieved.

The chemistry laboratory of the Museum has long been concerned with providing analyses of archaeological specimens to assist in their precise identification. In recent years, increasing emphasis has been placed on the stabilization of specimens to prevent any further disintegration due to excessive damp or dryness or to the industrial atmosphere.

The radiocarbon laboratory, one of the few in the world that has devoted itself almost exclusively to the dating of archeological and anthropological samples, has published over 1,000 C^{14} dates, representing 113 archaeological sites and contributing to the establishment of chronologies for four main regions of the world —the Near East and Mediterranean regions, Central America, South America, and the Arctic. Among its intensive studies have been the correlation of the Mayan calendar with the Christian, the dating of some of the earliest sites and the elucidation of human migrations in the western Arctic, the dating of occupations and climatic sequences for what is apparently the earliest site in eastern North America, and comprehensive dating programs permitting archaeological interpretation of Mesolithic-Neolithic-Chalcolithic transitions in the Near East and the Anatolian Plateau.

A program in dendrochronology (tree-ring dating), being conducted in collaboration with the University of Arizona, is providing samples of *Sequoia gigantea* and *Pinus aristata* of known age (back to 5100 B.C.) for C^{14} dating in an attempt to detect small fluctuations in the atmospheric C^{14} inventory in the past. When the magnitude and duration of these fluctuations are known, it may be possible to correlate them with changes in cosmic-ray intensity, the intensity of the magnetic field of the earth, and/or the equilibrium conditions (the balance between the atmosphere and oceans). The C^{14} dates for these samples of known age will also provide correction factors for the dating of archaeological specimens of unknown age.

The MASCA Information Center maintains a catalogue of scientific techniques of value to archaeology and anthropology, consisting of abstracts of articles, references, and information on new developments culled from many publications in diverse fields, as well as unpublished material gathered from correspondence and experimental notes. A newsletter, in which current developments in the field of techniques are reported, is published approximately three times a year. Copies are made available, free of charge, to all interested persons. The mailing list and the roster of contributors are international. There is a continuing need for notes and reports. All persons engaged in work involving new techniques applicable to archaeology are urged to send information to Jeannette Flamm, Editor, *MASCA Newsletter*, The University Museum, 33rd and Spruce Streets, Philadelphia, Pa. 19104, U.S.A.

Conference

Summer School in the Sociology of the Hill Regions of North-Eastern India: Human Factors in the Socio-economic Development of the Hill Regions. October 3–8, 1968, St. Anthony's College, Shillong (Assam), India.

Sponsored by the Department of Sociology, University of Delhi.

Organized by M. N. SRINIVAS, Head of the Department of Sociology at the University of Delhi.

Participants and the themes of their papers:

1. *Social factors in agricultural development*

A. P. SINHA, Sagar (Madhya Pradesh).
P. C. KAR, Tura (Garo Hills).
B. M. PUGH, Shillong (Khasi Hills).
P. C. GOSWAMI, Jorhat (Assam).

2. *Social factors in industrial development*

D. S. SARMA, New Delhi.

3. *Bureaucracy and economic development*

D. N. MAJUMDAR, Tura (Garo Hills).

4. *Education and social change*

E. H. PAKYNTEIN, Shillong (Khasi Hills).
H. BAREH, Kohima (Nagaland).
L. R. N. SRIVASTVA, New Delhi.
M. D. PUGH, Shillong (Khasi Hills).
N. K. SYAMCHAUDHURI, Shillong (Khasi Hills).
P. MOASOSANG, Kohima (Nagaland).
S. K. GHOSH, Simla (Himachal Pradesh).

In addition, J. K. BOSE, Calcutta, presented a paper on acculturation among the Garo and R. T. RYMBAI, Shillong, on the Khasi view of life. The School was inaugurated by B. K. NEHRU, Governor of Assam and Nagaland, and the valedictory address was delivered by G. G. SWELL, Member of Parliament.

Discussion:

Some important points emerging from the discussions were:

1. Governor Nehru, in his inaugural speech, emphasized the need to redefine "tribe" in the context of the hill regions. The Summer School considered substituting for "tribe" such alternatives as "hill people" or "hill folk", but felt that the term could not be discarded in view of the fact that the "Scheduled Tribes" are an important constitutional category.

2. The hill people show a keen desire for education, and this concern was reflected in the large number of papers dealing with this theme. It was felt that the kind of education that should be given to the hill youth needs to be discussed in a greater depth. Certain reforms in the educational system were thought to be essential in order to give greater importance to technical and science education. It was also felt that the cultural gap between educated youth and

Egyptian date

1321

1870

Astro fixes

Medit. and K & R

NSF Grant SOC 75-04203
Museum Applied Science Center for Archaeology (MASCA)
Two-Year Report 3/1/75 - 2/28/77

by

Froelich Rainey, Principal Investigator
Elizabeth K. Ralph, Faculty Associate

The overall activities of MASCA are described in Froelich Rainey's accompanying letter. Some of the detailed research projects are reported in the enclosed MASCA Newsletters, vol. 11, nos. 1 and 2 and vol. 12, nos. 1 and 2. Specific subjects are as follows:

I. Thermoluminescence (TL)

A) "Effects of Alpha and X-Ray Doses and Annealing Temperatures upon Pottery Dating by Thermoluminescence" by Mark C. Han, (MASCA, vol. 11, no. 1, pp. 1-3).

The important discovery was the fact that the sensitivity of pottery to radiation damage is increased with increasing original firing (or annealing) temperatures. This may necessitate the use of different calibrations for each range of firing temperatures.

B) "The Thermal Behaviour of Clays and Possible Methods of Determining Firing Temperatures of Pottery" by Julia L. Handy and Alan M. Gaines (MASCA, vol. 11, no. 1, pp. 3-4).

This was a supplemental study in conjunction with (IA), but was more basic in regard to the mineralogy and thermal behaviour of clays. As mentioned, more studies of dehydroxylation are required.

C) "Analyses and Thermoluminescent Dating of a 'Chung'" by John P. Rappolt (MASCA, vol, 11, no. 1, p. 10).

This bronze bell contained fired "earth" within its handle which

enabled it to be dated by TL. The date of 1500 B.C. is consistent with its style. In addition, chemical analyses revealed that the so-called bronze consisted of 99% copper.

D) "TL Dating of Burnt Soil" by R.J. Carpenter and K. Ryan (MASCA, vol. 11, no. 2, p. 7).

A TL date consistent with ^{14}C dates and the late Iron Age chronology of the ceremonial site was obtained with a sample of burnt soil from Dún Ailinne, Ireland.

E) In addition to the published reports, many series of sherds have been dated. The major projects recently were concerned with samples from the University Museum's excavations at Ban Chiang, Thailand and from Las Flores, Coamo, Puerto Rico. Long series of both TL and ^{14}C dates have been obtained and the correlations are being studied.

F) Germanium Detector

The use of a sensitive Lithium-doped Germanium Detector with associated components, both made available for temporary experimental use by Prof. Wm. Stephens in the Tandem Accelerator Facility, Department of Physics, has enabled the total inherent radioactivity in pottery to be measured for the first time. The Germanium Crystal is an extremely sensitive detector of gamma rays in the ranges of energies emitted in the decay series of Uranium and Thorium in pottery as well as the beta emissions from ^{40}K. The measurements provide the exact ratio of U to Th and also indicate the absence (or presence) of radon and possibly thoron escape, both of which are gases which affect the overall dose of inherent radioactivity.

Comparisons of the total radiation doses in pottery as measured with the Germanium Detector are in good agreement with our previous overall

alpha-counting of U and Th combined, and with flame photometric determinations of ^{40}K. However, much more information is provided, especially in regard to the U/Th ratios (essential for "absolute" TL dating) and the possible escape of radon.

The use of the new Germanium Detector is such a significant breakthrough that it will soon be copied by M.J. Aitken at Oxford University.

II. Near and Remote Sensing

A) Soil-Penetrating Radar

It is anticipated that soil-penetrating radar will complement our standard techniques of archaeological prospecting. It can be employed at sites with magnetic clutter where magnetometers are not suitable. Also, at many sites it has the capability of providing more information and greater penetration in depth than resistivity surveying and is also much faster to use.

1) "A Communication on an Archaeological Radar Experiment at Chaco Canyon, New Mexico" by Roger S. Vickers and Lambert T. Dolphin (MASCA, vol. 11, no. 1, pp. 6-8).

This was the first experiment conducted jointly by Stanford Research Institute (SRI) and MASCA at an archaeological site with the new SRI soil-penetrating radar equipment. Chaco Canyon is a suitable site because of the dryness of the earth and the consequent contrast in dielectric constants between the soil and the buried structures. Some features were detected and much was learned in regard to improvements in the apparatus and especially the method of recording the results to make the system more practical.

2) "Ground-Penetrating Radar for Historical Archaeology" by Bruce Bevan and Jeffrey Kenyon (MASCA, vol. 11, no. 2, pp. 2-7).

This experiment was conducted jointly by Geophysical Survey Systems (GSS), Inc. and MASCA at an historical site with similar but commercially available soil-penetrating radar equipment. Anomalies were detected which represented known and possibly unknown buried features.

B) Magnetometer Survey

1) "A Magnetic Survey at Les Forges du Saint-Maurice" by Bruce Bevan (MASCA, vol. 11, no. 2, p.1).

This was a cesium magnetometer survey conducted in a region of a former iron industry. Therefore, anomalies were large and gradients difficult to interpret. However, there was some correlation between anomalies and possible archaeological-historical features.

2) Other magnetic surveys

"A Magnetic Survey at Quirigua (Guatemala)", by Bruce Bevan, to be published in Quirigua Papers, University Museum.

At this Mayan site in Central America, a stone structure, possibly a buried causeway, was traced with a cesium magnetometer. While the primary architectural stone at the site furnished no magnetic contrast, magnetic river cobbles used as foundation fill allowed indirect detection of this feature.

In collaboration with the University of Illinois, a magnetic survey was made at Cahokia Mounds,near St. Louis, in August 1976. The magnetic gradients were extremely small and no definite detection of Indian earth works was possible in the area which was mapped.

Additional surveys were made by MASCA staff at Governor Printz

Park and at Yellow Springs, both near Philadelphia. The excavation of these sites has just begun, and so the value of these surveys is not yet known.

C) Soil-Penetrating Radar and Magnetic Survey

At one of the MASCA test sites in Valley Forge National Historical Park, the area was surveyed with GSS soil-penetrating radar. The differing soil strata were revealed clearly, and a prominent linear feature was detected.

This linear anomaly was not detected in a subsequent cesium magnetometer survey, which indicates that it is not a "modern" iron pipe, but may be of greater interest.

D) Resistivity Surveys

1) Members of MASCA demonstrated the use of the Geohm (resistivity instrument) and instructed associates of the Mount Clare House (Baltimore, Md.) in its use. Members of their archaeological society have continued to conduct surveys at the site throughout the summer (1977). In the course of the demonstration, one out-building was detected and it is anticipated that others will soon be reported.

2) Resistivity surveying has been resumed (summer 1977) at Dún Ailinne, Ireland, especially in search of the entrances of the fortification walls.

E) Aerial Photography

In conjunction with magnetic surveys, aerial photographs for reconnaissance and site illustration were taken at Les Vieilles Forges in Canada, Quirigua in Guatemala, and at Yellow Springs in Pennsylvania.

III. Mud-Brick and Stone Preservation

Dr. Darrel J. Butterbaugh, a chemist and Research Associate (volunteer) at MASCA has conducted research since 1972 toward the development of suitable methods for the conservation of mud-brick and stone structures, especially at archaeological sites. Acrylic emulsions and catalyzed mixtures of methacrylate monomers and solution polymers have been tested.

Initial experiments have been conducted in the laboratory and treated samples are then cycled artifically - wet-freeze-thaw, simulated ground water with paper wicks and airfans, sandblasting, etc. Out-of-door endurance tests are then performed locally on Museum roof and objects in the gardens as well at an exposure station at Florida Atlantic University in Boca Raton. Actual field tests on mud-bricks have been conducted at Chaco Canyon, New Mexico; Quirigua and Chimaltengo, Guatemala, and Hasanlu, Iran. Inspections after one year or more have illustrated that the treated walls are withstanding weathering and erosion extremely well and have indicated which treatments are best.

Additional tests have been made recently in the laboratory on samples of Greek marble and stone from Petra which may lead to experiments at the sites.