June 3, 1974

From the desk of

ELIZABETH CHESLEY BAITY

Dear Dr. Ralph:

From all accounts you are generous with information, and I need badly and urgently some information about calibrated C14 dates for both Western Asia, the Indus culture, and Egypt.

I had expected to have about 8 months to work on this new synthesizing review before giving it any publicity at all, but as Dr. Claude Schaeffer cannot make it to the McMaster's seminar and the program must have a report on the Btonze Age cultural discontinuities, evidence and explanation, I have reluctantly agreed to go and at least present some of the problems.

As you know, chronology heads the list. If I am to see whether or not the destructions appear to match up in larger areas I must have accurate radiocarbon dating. And I cannot find it in any of the reports I have on hand.

I would deeply appreciate it if you would answer the questions you can, and return the enclosed sheets, along with any data you may have on these specific regions. Anything from Chinese archaeology?

When I have this review better in hand I am going to investigate the possibility of having a one-day seminar at your

institution; we just do not have the necessary supporting departments either at UNC or Duke, but you have about everything essential. But first I have a lot of work to do.

I have your 1973 MASCA calibration but the problem is, the excavation reports I have do not state whether they base chronology on calibrated dates or not, so I assume they do not.

Sincerelyo yours,

Elizabeth Chesley Baity

Elizabeth Chesley Baity (PhD)

If you have not seen and would like to have a personal copy of my review of archaeoastronomy (Current Anthropology October 1973), tell me. I have xeroxed a number of them.

I would greatly appreciate having your article in Radiocarbon Variations, not ava available here.

1503 Mason Farm Road
Chapel Hill, NC 27514

Elizabeth Chesley Baity, Ph.D.
1503 Mason Farm Road
Chapel Hill, North Carolina 27514

RESEARCH QUESTIONS FOR A SYNTHESIZING REVIEW, "BRONZE AGE CULTURAL DISCONTINUITIES: EVIDENCE AND EXPLANATION"

I. Invasion hypothesis (as Wheeler on Indus, Mellaart on Western Asia, etc.)

1. What sources (archaeological or other) do you consider most reliable with regard to the Bronze Age cultural discontinuities in Western Asia, Crete, Greece, Anatolia, Iran, the Indus Valley, China?

2. Which cite archaeological evidence indicating that site destructions in Western Asia, c. 23rd, 16th, and 12th centuries B.C., respectively, were simultaneous, as argued by Claude Schaeffer (1948)?

3. What evidence, archaeological or other, suggests that these destructions were also simultaneous with the arrival of new populations?

4. What evidence indicates that the invaders settled down fairly quickly at destroyed sites?

5. Are there new and reliable sources on the identity of the Peoples of the Sea?
6. Evidence indicating why they migrated in such numbers from their home areas?

II. Drought hypothesis (as Bell on First Egyptian Dark Age, Carpenter on Mycenaean Dark Age, etc.)

1. Is there recent evidence (from archaeology, earth sciences, or other) which supports the drought hypothesis with reference to the Dark Ages cited?

2. Evidence in conflict with this hypothesis?

3. Discussions of the disparity between the postulated indications that these Dark Ages were caused by prolonged drought, and the actual evidence that in Western Asia and Egypt, site destructions were violent and often followed by fire?

III. Local disaster hypothesis (as Raikes/Dales on the end of the Indus cities and various authors on the eruption of Thera as the cause of the destruction of the Minoan thalassocracy)

1. Recent objective evidence (or analyses) from geologists, archaeologists, and others with reference to other local tectonic and/or volcanic action at the times of the Bronze Age destructions and the Dark Ages?

2. On local disasters in their home areas as the cause of the migration of the Sea Peoples?

3. Evidence supporting/disproving Schaeffer's hypothesis that the Western Asian Early Bronze Age site destructions were simultaneous?

4. Evidence that geologists and/or archaeologists have searched these and other sites for tephra and other evidences of vulcanism?

5. Recent analyses of these contrasting hypotheses re the Indus City destructions as part of a larger natural disaster?

6. Recent calibrated radiocarbon dating of sites in these various areas?

7. Recent studies indicating survival of Minoan prosperity after the Thera eruption?

IV . Ecological exhaustion (as Possehl on the decline of the Indus culture)

1. Recent data or analyses supporting Possehl's explanation?

2. Has anyone compared Indus radiocarbon dates with corrected C_{14} or stratagraphic dating for the Western Asian destructions?

3. What is an accepted chronology for the proto-Indian civilization?

4. Does the ecological explanation hold for the destruction of the colonial sites at Bahrein and on the adjacent Arabian coast?

5. Does the ecological exhaustion hypothesis hold for Olmec sites? early Mayan sites?

V. Shifts of Earth's rotational axis (as postulated by Hapgood and others)

1. Is there an analysis of evidence that the earlier destructions and Dark Ages could have been connected with a slight shift of the earth's spin axis? (i.e., the orientation of the pyramids, etc.).

2. Has Hapgood's hypothesis of a fairly recent shift received support from geologists?

3. Is there textual (folkloric) evidence from early sources which support the hypothesis that the destructions and Dark Ages could have been related to such a minor shift of Earth's spin axis?

4. Archaeological or textual evidence proving that orientations, astronomical observations, etc. show no marked anomalies with regard to contemporary astronomical facts?

VI. Cosmic disaster hypothesis (as evidenced by Velikovsky)

1. Aside from the papers published in Pensée and those given at the AAAS Seminar in San Francisco, are there archaeological articles adequately discussing this hypothesis and offering new evidence pro or con?

2. Chronology: while archaeological evidence and radiocarbon dating do not appear to support the shortened Egyptian chronology correspondences, there are uncertainties with regard to dates, and I particularly solicit bibliographical references or personal communications with regard to the dates in real years of the major destructions and Dark Ages and especially of the New Kingdom and Cyprus.

June 7, 1974

Ms. Elizabeth Chesley Baity
1503 Mason Farm Road
Chapel Hill, No. Carolina 27514

Dear Ms. Baity:

In our MASCA information center, we are glad to reply to questions in regard to techniques derived from the physical sciences that are applicable to archaeological research.

Your questions, however, involve interpretations of all kinds of evidence so that I think that it would be better for you to "dig" out the facts in a good library.

If you would like to send me a list of specific C-14 dates with their laboratory numbers, I shall be glad to correct them for you, or tell you whether or not they have been corrected.

I have enclosed a copy of the article which you requested.

Sincerely,

E. K. Ralph

May 6, 1961

Mr. Richard G. Kelly
Laboratory Chemical Division
J. T. Baker Chemical Company
Phillipsburg, New Jersey

Dear Mr. Kelly:

In 1955, we inquired about the availability of calcium oxide with very low radium content, and on November 10, 1955 we ordered 40 lbs. of CaO, Baker Spec. No. 222-A, Lot 2240.

Is this still available or do you now have something more suitable? We would like to obtain 50 lbs. of CaO, free of radium, size: 14 to 20 mesh.

Sincerely yours,

Elizabeth K. Ralph

EKR/bg

Techniques

J. T. Baker Chemical Co.

September 2, 1964

Dear Dr. Schramm:

You will recall that after I spoke to your group about archaeology, we discussed the business of our Casting Department, here, and the possibilities of improving the materials. We were going to get together to discuss this after my return from Italy and Libya, but then I guess the summer got in the way.

Now I have another idea, and I would like your advice. We have been operating a Science Center for Archaeology, here, experimenting with various new techniques which can be applied to archaeology. One of our people working in Iraq tells me that they have a very real problem in trying to preserve excavated structures made out of sun dried brick. When they are excavated, these structures are damp and as they dry out they crumble and disintegrate. Some of these mud brick walls are 30 ft. thick and stand 30 or 40 feet high. There are many of such structures dating from more than 5000 years ago, which the Iraq Government would very much like to preserve. We would like to devise some system for preserving these structures, both for the sake of our work and for the Iraqi Government. It could develop into a major operation, because of the importance to the tourist trade.

I think we will have some funds to back this kind of technical research and I thought it may be just possible that you or some of your people might get interested in this. As I see it, we would probably have to drill into such walls to exhaust the moisture, then devise some preservative which could be sprayed on, over large masses of construction. Is this anything in your line?

I am off again on the 16th of September to Italy, and will be gone about one month, but if you have any ideas, I would certainly appreciate them.

Very best wishes,

Froelich Rainey
Director

Dr. Charles H. Schramm
Vice President and Technical Director
J. T. Baker Chemical Company
Phillipsburg, New Jersey

Techniques

October 29, 1964

Dear Dr. Schramm:

I am again back from abroad and would certainly like to talk to you in order to organize our attempt to preserve the mud walls in Iraq. Our crew will be going out shortly after the first of the year, and I do hope we can get you involved in this. I will be around at least until Christmas, but would it be possible for you to get down here for lunch, one day during November? I am committed for other things on the following days: November 4th, 5th, 7th, 9th, 10th and 27th.

The Museum is closed on Mondays. I should very much like to have you meet Mrs. Carter and David Crownover who work in Iraq and who know the problem better than I. Also, to give you a chance to see what we are doing in our Laboratory here. And, in any case, we would all enjoy seeing you.

I hope we can work this out,

Very best wishes,

Froelich Rainey
Director

Dr. Charles H. Schramm
Vice President and Technical Director
J. T. Baker Chemical Company
Phillipsburg, New Jersey

Technopres

December 17, 1964

Dear Dr. Schramm:

Thank you so much for sending on the bricks. They seem quite good. We are procuring additional samples, or at least trying to, at the moment. Tablets will be sent shortly. We talked to the Bartlett Tree people and for $100 we can get two valves and three different lengths of pipe.

I will be in touch,

Sincerely,

David Crownover
Executive Secretary

Dr. Charles H. Schramm
J. T. Baker Chemical Company
Phillipsburg, New Jersey

DJC/vg

J. T. BAKER CHEMICAL COMPANY

PHILLIPSBURG, N. J.

CHARLES H. SCHRAMM, PH. D.
VICE PRESIDENT
AND TECHNICAL DIRECTOR

December 9, 1964

Dr. Froelich Rainey
Director
The University Museum
University of Pennsylvania
Thirty-Third & Spruce Sts.
Philadelphia 4, Pennsylvania

Dear Dr. Rainey:

Last week we sent you some samples of brick which had been subjected to various stabilization techniques. I feel that it should definitely be possible to stabilize the formations in Iraq by the use of this method. Examination of the large brick specimen should be encouraging to you. I am looking forward to receiving an additional sample for some further investigations.

My best regards to you.

Sincerely yours,

Charles H. Schramm

CHS/jng

May 4, 1965

Dear Dr. Schramm:

I just have this note from T. A. Carter in Iraq, and hasteneto send it on to you in case you have any suggestions for her. The address is at the top of the letter. Apparently the thing as made quite an impression and we hope it will work.

Very best wishes,

Frbelich Rainey
Director

Dr. Charlex H. Schramm
J. T. Baker Chemical Company
Phillipsburg, New Jersey

FGR/vg

Techniques

July 29, 1965

Dear Charles:

I cannot thank you enough for your excellent critique of the mud-brick process. We are going to be working hard trying out some of the experiments as best we can, here. We are indebted to your for all your thought, time spent, and hard work.

May I add my warm personal thanks for the superb lunch you gave Mrs. Carter and me.

Sincerely,

David Crownover

Mr. Charles H. Schramm
J. T. Baker Chemical Company
Phillipsburgh, New Jersey

DJC/vg

December 27, 1962

COPY

Dr. Bryant Bannister
Laboratory of Tree-Ring Research
University of Arizona
Tucson, Arizona

Dear Bryant:

Many many thanks to you and to Dr. McGinnies for your kind hospitality during my visit in Tucson. Please extend my thanks too to Dr. Ferguson and your students and colleagues for the helpful talks I had with each.

I am slow in writing to you, and I haven't made much progress in the way of helpful suggestions for the publication and presentation of your Gordian results. Dr. Young continues to suggest a short summary in "News and Notes" of the American Journal of Archaeology plus the full account in your Bulletin. Dr. Rainey just doesn't like to worry about details nor does he have much time for them, but thinks that either Science or Nature would be appropriate.

I have failed also in finding out more about Giddings' piece from MM.

We hope to obtain C-14 dates for Dr. Ferguson's two floaters- 81B and 80B this week. If the results are exciting, I'll cable him when they are completed.

With best regards to you and to your family,

Elizabeth K. Ralph

EKR:dml

January 8, 1963

COPY

Dr. Bryant Bannister
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, Arizona

Dear Bryant:

Many thanks for your letter. I did enjoy seeing Dr. McGinnies in Philadelphia even though that Saturday was so hectic that I was exhausted at the end of it. To cap it off, I had to drive home (40 miles) in a wet slippery snowstorm.

No directive has yet appeared from Dr. Rainey about Gordion photographs, but Ellen is taking care of the matter today. There may be a small delay in getting prints made from the negatives, but they should be along shortly.

When I was visiting your laboratories, Mr. Dean showed me the bits (similar to hole cutters with saw-teeth) that he used successfully with a portable generator and hand drill. We have just acquired a Black and Decker battery-powered half-inch drill. Could you possibly send us one or two of your bits for use with it? If necessary, we can modify the ends to fit the chuck of our drill.

We hope to complete the C-14 counting of Dr. Ferguson's two floaters this week. First counting run of P-605(TRL 62-80B) indicates an age of 3100 B.P. or older.

I'm writing up a grant proposal for a number of projects including the pilot dendrochronological study in Egypt as outlined by you and I.E.S. Edwards. Shall send you a copy as soon as possible, and I hope I have your permission to list you as a "collaborating scholar."

With best regards to you and Betty,

Elizabeth K. Ralph

EKR:dml

DEPARTMENT OF GEOPHYSICS AND GEOCHEMISTRY

INSTITUTE OF ADVANCED STUDIES

THE AUSTRALIAN NATIONAL UNIVERSITY

TELEPHONE: CANBERRA 49 3406

TELEGRAMS: NATUNIV, CANBERRA

BOX 4, P.O.
CANBERRA, A.C.T.
AUSTRALIA 2600

13 June 1973.

Ms. E.K. Ralph,
University Museum,
33rd and Spruce Streets,
PHILADELPHIA,
Pa. 19104, U.S.A.

Dear Ms. Ralph,

I'm enclosing a reprint of our preliminary report on the geomagnetic excursion at 30,000 yr B.P. I'm afraid I only have an incomplete copy of the draft of the paper for the New Zealand Conference Proceedings, and letters to Tom Grant-Taylor have not yet produced a copy of the final version. I had been hoping to send you a copy ages ago - but I fear that you will see it at the same time as I will (when the Proceedings come out). If, by chance, I get a copy before then I'll send you a photocopy.

With best wishes,

Yours sincerely,

Mike Barbetti

(Michael Barbetti)

MICHIGAN
STATE HIGHWAY DEPARTMENT
1224 EAST ENGINEERING BUILDING
UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

H. E. BARNES
ASSISTANT DIRECTOR
TESTING LABORATORY

NORMANDY 2-4511

HOWARD E. BARNES
CIVIL ENGINEER
4800 E. TEXTILE ROAD
YPSILANTI, MICHIGAN

March 22, 1960

Dr. Froelich Rainey
Director, University Museum
University of Pennsylvania
Philadelphia 4, Pa.

Dear Dr. Rainey:

This will acknowledge receipt of your very interesting letter of March 16, 1960. I was amazed to learn that resistivity instruments were being used for archaeological investigations, and consequently must admit that I am quite uninformed of the work being carried on by Professors Case and Lerici in this connection.

However, I can appreciate that the use of earth resistivity might be quite helpful within the scope of its limitations. By limitations I am not making implications toward any particular type of instrument, but rather I am referring to the general method of earth resistivity as a tool of investigation.

Most of the cases described in your letter would appear to have justifiable reasons for the results obtained. For instance, you have stated that the reading of conductance obtained with the presence of a deep mantle of light dry soil was comparable to the reading obtained with the presence of a buried monument. Inasmuch as the conductance of an electric current varies with the degree of moisture, I think it could be anticipated that the deep layer of light dry soil should give high readings perhaps comparable to the monument readings. The condition described involving the two artificial mounds where unusually high resistance was obtained could be explained if the material were extremely light and dry.

In answer to your question regarding the possibility of rewiring the instrument, I would have to answer in the negative. I believe the solution of betterment does not lie with this instrument or any other resistivity instrument. A great amount of study has been made in the last 50 years by physicists and geophysicists in an attempt to improve instrumentation, and any of the present-day instruments embody the best features known at the present time. A resistivity instrument is not a resistance meter in the true sense, but is a device which measures

the potential drop between two equipotential lines of force having already taken into consideration the three-dimensional current distribution effect. It must be acknowledged that the current distribution is affected by many factors and the measured potential drop is often most unexplainable unless these factors are known. Some of the more common factors are: water, and types thereof; particle size; porosity; type and thickness of particle coating; types of particles with respect to geological origin; flat or undulating ground surface; and so on. Consequently, one must expect to obtain like readings for certain unlike conditions and unlike readings for certain apparently like conditions.

With respect to the quality and dependability of the Model 274M Michimho, I can testify that the Geophysical Unit of the Michigan State Highway Department has been using three such instruments for a number of years on daily routine exploration work and has acquired an unquestionable respect for them. For the type of work you are doing, I know of no other instrument which can offer as many advantages in your favor as the Michimho.

Since my experience with resistivity interpretations has been somewhat different than in the field of archaeology, I must make some reservations as to the amount of help which I may be able to give. However, I would certainly welcome the opportunity to try my best in this fascinating field.

Very truly yours,

Howard E. Barnes

HEB:a

Howard E. Barnes, P.E.

Resistivity

April 14, 1960

Mr. H.E. Barnes
Assistant Director
Testing Laboratory
Michigan State Highway Department
1224 East Engineering Building
University of Michigan
Ann Arbor, Michigan

Dear Mr. Barnes:

I am sorry for the delay in answering your letter of March 22, but I am much in a rush trying to get off to Egypt.

Your comments on our restivity experiment in archaeology have been very helpful and I hope to be in touch with you again after I return in June. I will be able to spend a few days with Lerici in Italy to see what he is doing with the equipment and also I hope to see Case at Oxford. We hope to continue with this equipment all next year.

Best wishes,

FR:ah

Froelich Rainey
Director

January 25th, 1974

Ms Marlene Beatty
1598 Arndt Road
Pittsburgh, Pa. 15237

Dear Ms Beatty,

Your letter of January 17th has been given to me, but I am not sure that you are interested in our labs in which we do thermoluminescence dating, C-14 dating, and other techniques derived from the physical sciences.

If you are interested in anthropological labs, it would be better to write to the Department of Anthropology. The Director of Anthropology is Dr. Ruben Reina.

Sincerely yours,

Elizabeth K. Ralph

1598 Arndt Rd.
Pittsburgh, Pa. 15237

January 17, 1974

Director, University Museum
University of Pennsylvania

Dear Sir,

As a high school teacher, I am interested in collecting a variety of material for my anthropology course. I would like to know if it would be at all possible for me to visit the museum and the labs for the purpose of making slides for use in my classes. I had visited the museum and three of the labs several years ago and I feel a presentation of this sort would be most appropriate. If this would be possible, a Friday or a Saturday within the coming month would be most convenient.

Thank you,
Marlene Beatty

Not for MASCA

Rick,
Any ideas?

VASSAR COLLEGE
POUGHKEEPSIE · NEW YORK 12601
Department of Chemistry

Dr. Elizabeth Ralph
Applied Sciebce Center for Archaeology
University Museum
33rd Street and Spruce Street
Philadelphia, Pa. 19174

July 19, 1974

Dear Dr. Ralph:

As result of discussions at the Fifth Symposium of Archaeological Chemistry last year, and subsequent discussions with the officers of the Association for Field Archaeology (AFFA), I am working on a kind of archaeometric clearinghouse which is to be printed periodically in the newly established Journal of Field Archaeology.

The purpose is, very briefly, to let archaeologists know who among the archaeometrists in America is working with what materials by which techniques, and what answers (date, provenience, manufacturing techniques, etc.) can be hoped for.

One of my jobs is to prepare a mailing list so that I can get a large number of entries. I am doing that essentially by searching the literature in order to add names beyond the ones I know personally.

The other thing is to ask sensible questions so that I will get useful answers. My first notion was a sort of questionnaire, but this soon grew in complexity and still did not seem to allow for all eventualities. I dislike questionnaires: there never seems to be a box for the answers I want to give. I am now inclined to invite statements and sift through them to compile my list. This is more work, but I think it may give better results.

As I was turning these problems over with Dr. Charlotte Moore, Assistant Editor of JFA, she suggested that I write to you for advice, and that is what I am doing now. I have no business taking much of your time, and I don't mean to, but I would be very grateful for your reaction, as general or as specific as you please. If you would jot down your thoughts on this matter sometime during the next month, it would be a help to me and it would that first list a more useful thing, - which is, after all, what it is all about. I am leaving for Europe tomorrow and won't be back until mid-August, and for all I know you may be somewhere in the field. In any case, I do not expect to mail my questions until September, when everyone is back home, and I hope to put together the ms during my Christmas vacation.

I do apoligize for intruding upon your time, but I know that communication between field archaeologists and archaeometrists is something you believe to be as important as I do.

Sincerely yours,
Curt W. Beck
Curt W. Beck

August 2, 1974

Dr. Curt W. Beck
Department of Chemistry
Vassar College
Poughkeepsie, New York 12601

Dear Dr. Beck:

Your idea of an archaeometric clearinghouse sounds good.

At the moment I have only two specific contributions. One is the enclosed write-up (slightly out-of-date) of our MASCA labs. Another suggestion is that we could send you a copy of our MASCA Newsletter mailing list, which includes almost 3000 names.

If you are interested in the latter, please let me know.

Sincerely yours,

Elizabeth K. Ralph

ENC:1

[DONALD BEER]

Cia Hotelera del Perú
Hoteles del Estado

ADMINISTRACION GENERAL
DEPOSITOS y RESERVACIONES

HOTELES

Av 28 de Julio Nº 948
Teléfono Nº 38440
Cables "PERUHOTEL"
Casilla Nº 1213
LIMA — PERU

HOTELES:

ABANCAY
AREQUIPA
AYACUCHO
CAJAMARCA
CAMANA
CONTUMAZA (Hostería)
CUSCO
CHALA
CHICLAYO
HUANCAYO
HUANCAVELICA
HUANUCO
HUARAZ
HUARMEY (Hostería)
IQUITOS
MACHU - PICCHU
NAZCA
PACA (Albergue)
PISSAC
PIURA
PUNO
SAN RAMON
TACNA
TARMA
TINGO MARIA
TRUJILLO
TUMBES
URUBAMBA
YURA (Baños Termales)

Hotel de Turistas
Cuzco, Peru
December 1, 1965

Miss Elizabeth Ralph
University Museum
University of Pennsylvania
Philadelphia, Penna.

Dear Miss Ralph:

When you turned over to me the magnetometer and resistivity equipment, you asked me to return it before the end of the year because it had been promised for another job in January. I am writing to inform you of my schedule in the hopes that it will not conflict with your plans after your kindness. We are leaving here on the 13th of the month to go to Lima where we hope to photograph some of the Inca objects in private collections. We will leave the Hotel Bolivar there in time to return to New York before Christmas. I have a meeting in New York on the 27th and have consequently made tentative plans to travel to Philadelphia on the 28th if this is all right with you.

We have been able to accomplish much less than we hoped, but we have some very fine results to write up. The nature of the magnetic field and its diurnal variations forced us to adopt much more rigid controls than are necessary in the northern latitudes, and some highly magnetic clay-like stones created constant interference in one area. All in all it will be a very interesting report.

Although the Lima papers have been writing about fantastic discoveries including tunnels, mummies, and especially gold, our only significant finds include a pre-Incan site near Cuzco and helping in the location of a buried pottery dump, probably buried by Dr. Valcarcel when clearing Sacsahuaman in 1935.

If you have any comments about the return of the equipment, please write to me at the Hotel

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DEPOSITOS y RESERVACIONES

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CHICLAYO
HUANCAYO
HUANCAVELICA
HUANUCO
HUARAZ
HUARMEY (Hosteria)
IQUITOS
MACHU - PICCHU
NAZCA
PACA (Albergue)
PISSAC
PIURA
PUNO
SAN RAMON
TACNA
TARMA
TINGO MARIA
TRUJILLO
TUMBES
URUBAMBA
YURA (Baños Termales)

Bolivar, Lima before the 19th or better to my home in New York, 14 East 63rd Street, N.Y.

Looking forward to seeing you soon.

Sincerely,

Donald Beer

Donald A. E. Beer

UNIVERSITY OF CAMBRIDGE

Reader in Experimental Geophysics:
B. C. BROWNE, M.A.
Reader in Theoretical Geophysics:
R. STONELEY, SC.D., F.R.S.

TEL. 52103 CAMBRIDGE.

DEPARTMENT OF GEODESY & GEOPHYSICS
MADINGLEY RISE
MADINGLEY ROAD
CAMBRIDGE

21st February, 1961.

Miss E.K. Ralph,
Department of Physics,
University of Pennsylvania,
Philadelphia, 4, U.S.A.

Dear Miss Ralph,

Thank you for your reprint from "Nature". Eric Willis also told me of his meeting with you in New York recently.

My main purpose in writing is to make some enquiries about Professor Rainey. I wrote him some weeks ago about the Conference on Archaeological Prospecting, which we will hold in London next month. I reserved space for him (or another from your group at Philadelphia) on the preliminary programme, remembering as I did the interest he earlier expressed about coming to discuss your work in Mexico. Could you please,

1. tell me if Rainey is away from Philadelphia and if so, whether or not my letter will have reached him;

2. say if you think someone will be able to attend or not;

3. outline briefly the work in Mexico - the Archaeological setting and details of the methods used in Prospecting?

Even if someone cannot attend from the museum, I would like to have your work mentioned in the course of the conference.

As soon as the conference is out of the way, I will be summarizing our last two years' work in archaeo-magnetism im preparation for publication. I'll keep you informed of progress on this. Are you likely to attempt such a programme soon?

I may try to visit Philadelphia in early June; again on my way to the West Coast.

I enclose a copy of the conference programme for you.

Yours,

P.G.P.
p.p. John Belshé.

25 February, 1961

Dr. J. Belshé
Department of Geodesy and Geophysics
Madingley Rise
Madingley Road
Cambridge, England

Dear Dr. Belshé:

Many thanks for your timely letter. I hope that you will forgive us for being so remiss in replying about the Conference on Archaeological Prospecting. Dr. Rainey was away for three weeks, and I think that he wrote to you in haste upon his return.

Dr. Rainey, unfortunately, is not able to attend, and there was some question about Richard Linington's (the person who is working actively here with instruments for archaeological prospecting) being able to return in time from Texas. Mr. Linington has returned and will attend the conference. He would like to report briefly on his experiments with sonar instruments.

We are indebted to you for organizing and including us in this excellent conference. I regret that I shall not be there, but shall benefit "second-hand" when Mr. Linington returns.

I hope that you will have time to visit us in June.

With best regards, I am,

Sincerely yours,

Beth Ralph

Elizabeth K. Ralph

UNIVERSITY OF CALIFORNIA, LOS ANGELES

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

UCLA, INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS
LOS ANGELES, CALIFORNIA 90024

November 9, 1972

Dr. Elizabeth K. Ralph
Department of Physics
University of Pennsylvania
Philadelphia, Pennsylvania 19104

Dear Dr. Ralph:

Dr. Rainer Berger is presently being considered for promotion from the Associate Professorship to the Professorship. An integral part of our promotion procedure involves letters from scholars outside the University of California system regarding the qualifications of the candidate. I would be most grateful to you if you could indicate to me your assessment of Dr. Berger's qualifications as a research scholar and his contributions to the earth sciences. I would appreciate a reply at your earliest convenience. Your reply will be held in strict confidence.

Sincerely yours,

Leon Knopoff

Leon Knopoff
Associate Director

lk/jl

November 14, 1972

Dr. Leon Knopoff, Associate Director
UCLA, Institute of Geophysics and
Planetary Physics
Los Angeles, California 90024

Dear Dr. Knopoff,

During the past several years, I have had several telephone conversations with Dr. Rainer Berger, and I met him "face-to-face" just recently at the International Radiocarbon Conference in New Zealand. In each contact I have been favorably impressed with his personality and his scientific ability.

However, I have never actually worked with him nor do I know him very well. From my "surface" observation, though, and from his publications, I recommend that he be promoted to the Professorship.

Sincerely yours,

Elizabeth K. Ralph

EKR/lk

UNIVERSITY OF CALIFORNIA, LOS ANGELES

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UCLA, INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS
LOS ANGELES, CALIFORNIA 90024

December 27, 1972

Dr. Elizabeth K. Ralph
The University Museum
University of Pennsylvania
Thirty-Third and Spruce Sts.
Philadelphia, Pennsylvania 19104

Dear Dr. Ralph:

Thank you for your recent letter responding to my request for information concerning Dr. Rainer Berger. Letters from sources external to the University represent an invaluable resource in the decision-making process regarding candidates for promotion. I can reassure you once again that your response will be kept confidential.

As I must be away from campus when this letter is typed and ready for signature, I am asking my administrative assistant to sign it for me.

Sincerely yours,

Leon Knopoff

Leon Knopoff
Associate Director

lk/jl

Popular Mechanics article

Aircraft Technique

July 10, 1962

Mr. Theodore Berland
2840 Berwyn
Chicago 25, Illinois

Dear Mr. Berland:

Enclosed is the recent copy of Expedition which you requested. Also a copy of a paper presented at Fort Belvoir on March 20. I hope these give you the information you desire.

If you do complete an article on the work in Italy done by Dr. Rainey and Mr. Lerici, we would request that you submit a copy of the article for approval by Dr. Rainey before publication.

Sincerely yours,

Mrs. John Dellevigne, Jr.
Secretary to Dr. Rainey

Theodore Berland
2840 Berwyn Ave.
Chicago 25, Ill.

Archeology Enters the Space Age

WANTED: PHYSICISTS WHO CAN DIG

By Theodore Berland

Revised & corrected TBR

In a barren Italian field some 20 miles northwest of Rome, within a stone's throw of the Mediterranean, a sport-shirted grey-haired man pokes a 15-feet long pipe into a hole in the ground.

At the end of the pipe is an eyepiece; soon it is all that can be seen of the device. The man turns on a switch and a bulb at the sunken end of the periscope flashes on.

Like an upside down submarine skipper, he looks around. What he sees amazes him.

Through the periscope's lens he sees a large room: on its walls are beautifully colored paintings of robed men on chariots pulled by handsome horses, of boys playing games, of fierce-looking animals. There is also a pile of decorated earthen dishes and vases. And, finally, a skeleton resting serenely on a slab of stone.

The Italian looking into the periscope is viewing the tomb of an Italian who died ~~some~~ 2500 years ago in the lost city of Cerveteri. Without a spade of earth being turned, one of the major archeological discoveries in recent years is taking place.

The remains in this subterranean tomb are those of an Etruscan, a citizen of a nation that ruled Italy even before the Romans. Unlike the Romans, though, the Etruscans left no written history of their great civilization. In fact, we still know

little about their language.

But we have learned a lot about their tombs. The first was discovered in 1827 at Tarquinia, about 40 miles northwest of Rome. A few more were found each year until 1894. Many had been already sacked by ancient grave robbers, but some still had pottery in them. Most were plain, but a few--those of rich Etruscans, apparently--had magnificent collections of art.

Like the ancient Egyptians, the Etruscans believed in an afterlife. They were buried with familiar possessions for use in the next world. The paintings on the tomb walls depicted pleasant activities that, they believed, would be continued after death.

The 19th century tomb finders were rank amateurs as far as archeology was concerned. They took what they had grabbed back to their homes, never made records of what they found or where they found them, and covered up the tombs again.

Some of these plundered objects made their way, finally, to museums, where professional archeologists started putting the pieces together. There were, the archeologists found, several Etruscan necropolises--or "cities of the dead"; among them were 24 painted tombs.

It took a cunning, 72-year-old Italian engineer named Carlo Maurilio Lerici to start the new search for Etruscan tombs. In 1957 he found the first new one in 63 years. Since then he has discovered 4,700 of them, 40 rich in paintings and pottery. And the skeleton he found at Cerveteri was one of the few that ancient grave robbers had missed.

The nice thing about Lerici's periscope to the past is that it's so efficient an approach. Rather than start a crew of men

digging away to uncover a tomb that might prove to be barren, he drills a hole through the top of it, puts his periscope in, looks around, and sees what's inside. This saves much time and money since, he finds, 98% of the tombs have been robbed and 60% have been completely ransacked.

The periscope idea is just one item in Lerici's revolutionary and efficient approach to find records of ~~the~~ our past. In effect, he has injected science into archeological digging.

Interviewed near Rome, Lerici explained that his new ideas met with great resistance from professional archeologists when he presented them a few years back. "We have raised a big scandal in archeology," he told me in his halting English. "Archeologists are the most conservative scientists. They are still using the methods they used four centuries ago. Well, I'm no archeologist. I'm an expert at finding what's buried in the ground. In four years we've done as much work as it would take classic archeologists a century to accomplish."

However, some archeologists have swung ~~xxx~~ over to Lerici's side and realized that new scientific instruments can catapult archeology into its golden era.

Dr. Froelich Rainey, a University of Pennsylvania archeologist, was one of Lerici's first converts. Interviewed in his office at the University Museum in Philadelphia (where he's the director), he predicted that "I think we are going to open up a whole new chapter in archeology."

Lerici, he told me, was a bit too impatient with professional diggers such as himself. "But basically he's right," Dr. Rainey said. "We've introduced only modifications into archeological methods. It's much like aviation. For years there were just

changes in the gasoline engine. Then came a whole new concept: the jet engine. Well, in archeology, we want to make a jet."

Lerici's first new trick was aerial photography. He spotted the Etruscan cities of the dead by studying aerial survey photos taken by England's RAF during World War II and by the Italian Air Force since.

At Cerveteri, the Etruscans literally carved their tombs out of limestone bedrock that lies just below the soil. First they dug sloping ramps, then they chiseled out huge tomb rooms, sometimes putting up a wooden post to brace the slab ceiling. After burial, the tomb was sealed, the ramp was filled with soil and a mound of earth was heaped on top.

From the air, the tombs can be spotted easily, particularly with cameras using red filters and infrared sensitive film. The deeper soil over the tombs and in the entrance ramps is more moist than the thinner soil that covers the bedrock between the tombs and around the necropolis. More moisture also means denser plant growth at the tombs. On infrared film a necropolis stands out cleearly as a mass of white spots.

Lerici has used aerial photos, too, to find ancient buried roads and building foundations not only in Italy, but in North Africa and in the Near East.

The next scientific trick up his sleeve was an electrical prospecting device. It works like this. Place two metal electrodes into the ground and pass an electrical current from one to the other and you can measure the resistance between them. If you move the eldctrodes farther apart, the resistance will increase in a uniform way. The farther apart the electrodes are, the deeper into the ground the current between them goes.

4 rods in a line are required for the two centeronos.

Now, if there is a tomb some place under and between the electrodes, the resistance will jump, since the dead air in the tomb is a poorer electrical conductor than the soil or bedrock.

Now turn the procedure around. If you take resistance readings every 10 feet and find a sudden increase, chances are good that there is something buried down there--probably a tomb.

For several years Lerici and his Italian crew used resistance equipment built by his own geological prospecting labs at the Lerici Foundation in Milan. In 1961 he was joined by Rainey and a handful of Pennsylvania archeologists. A new lighter, smaller, and transistorized German-made resistance device came on the market and they wanted to test it. Rainey used it to find Etruscan tombs at Tarquinia while Lerici used his own at Cerveteri. Then they compared notes. The German device won and that's what both teams now use.

But there is an even newer gadget--based on a principle of nuclear physics--which they have just turned to. It's the proton magnetometer, developed at the third center in the world trying to launch field archeology's jet age, Oxford University.

Oxford's new instrument is also lightweight and portable. It's copied from larger instruments used by nuclear physicists. It uses the jigglings of protons (positive nuclear particles) to measure exceedingly weak magnetic fields. In operation, one man monitors the magnetometer's electronics and dials, while the other walks 30 feet away from him and places a stake into the ground. One this metal stake is a plastic bottle filled with an organic liquid rich in free protons. Wrapped around the bottle is a coil of copper wire, connected by cables to the electronic circuitry.

It takes only three seconds for the coils' magnetism to jiggle the protons into phase resonance and another second and a

half to measure the jigglings caused by an outside magnetic field.

So sensitive is the magnetometer, Dr. Rainey explained, that "you just can't have any keys in your pocket, or it will throw the readings off. So, too, will a metal zipper on your trousers."

In the field, magnetic readings are taken every yard over a predetermined grid, then corrected for the effect of the earth's magnetic field, and plotted on a chart. When the chart is finished it is a contour map of magnetic intensities.

The buried object then either is a peak or a valley in the magnetic landscape.

At Tarquinia, for instance, where the Etruscans tombs are carved out of bedrock, they are where magnetism is lowest. Limestone is not very magnetic, but an empty tomb has even weaker magnetism.

In other instances, ancient remains register as highest magnetism. This is particularly true of pottery, because clay becomes magnetic during firing due to changes in its iron oxides. For some reason, too, when humans have lived for a while in one place, the iron oxides in the soil under their feet becomes more magnetic and can be a clue to modern diggers.

With these new tools of science--the proton magnetometer, electrical resistance instruments, drills powered by electricity or gasoline (one Lerici used had been designed to bore samples out of the surface of the moon), and periscope--a Lerici-Pennsylvania expedition in 1961 was able to locate and explore half a dozen Etruscan tombs a day. Without these new tools, it would have taken two months to find and search just one tomb.

Last Spring (1962), the Italian-American team used its new scientific prospecting tools on a new archeological adventure. The site of their search was on the flat plains off the Gulf of

Tarentum at the "instep" of the Italian "boot." There in the 8th Century B.C. the Greeks had built what became their most wealthy and magnificent colony, Sybaris. In 510 B.C. it was razed to the ground and the nearby River Crathis was diverted by the invaders to flood the ruins.

Only two necropolises and the ruins of a few outlying buildings have ever been found. The city itself was lost, buried beneath some 20 feet of mud, sand, and gravel deposited by the river through more than two millennia.

In the Spring of 1961, a Lerici Foundation team did some electrical resistance surveys near the River Crathis. When their measurements indicated that something was below the ground, they made test borings with an oil prospecting drill. This drill pumps water into its hollow bit shaft and drains it out of the hole so that it can be analyzed. Twelve feet into the mud, the bit hit something solid and sent up chunks of rock in the drain water. After a few more borings, Lerici's crew shoveled into the mud to find the top of a stone wall.

The next Fall, with the Pennsylvania team and the proton magnetometer, they made 400 perforations in two months and pinpointed a curving mile stretch of the wall. Then, last Spring (1962), excavating equipment and water pumps were brought in and the sand and mud was scooped up. Soon a bare masonry wall, hidden for centuries, stood again in the Italian sun.

The Sybarian wall told a story. Its top was of medieval construction; below that for 12 feet it was typical Roman brickwork; at the base were stone blocks such as used by 4th Century B.C. Greeks.

At first Dr. Rainey and his fellow archeologists thought that this had been a retaining wall that ran along the original course

of the River Crathis. But then they found chunks of pottery at the base on both sides. If this had been a retaining wall, pottery would have been on only one side, the city side. More likely, it was an aquaduct for carrying fresh water.

But as an aquaduct, it probably never served Sybaris. It's too new. In the 4th Century B.C., the Greek city of Thurii stood here; then, later, the Roman city of Copiae. So Sybaris still remains to be found. It may be buried deeper, or it may be farther up the River Crathis.

This April (1963), the Italian-American team will try again.

Both Lerici and Rainey are also planning other adventures for their new archeological prospecting tools. Lerici will apply his talents next to the remains of buried civilizations in the Near East.

Teammates of Rainey, who have already used the Lerici technique to find buried urns and skeletons at Cerro de las Lesas, Mexico (40 miles south of Vercruz), soon will start looking for buried colonial buildings at Harper's Ferry, W. Va., and for Indian burial sites in Michigan.

At the same time, the Pennsylvania museum has set up an Applied Science Center for Archeology to adapt more findings of basic research to archeological exploration. One of its hottest projects now is an underground sonar.

A pilot model tried at Sybaris didn't work too well. Now Texas Instruments of Dallas and the Petty Geophysical Co. of San Antonio are studying (under contracts) new facts about the acoustic physics of soil and performing experiments in beaming ultrasound waves at buried concrete blocks.

Also being developed are seismic prospecting instruments

sensitive enough to detect the shock waves of a hammer hit against steel on the ground. The theory is that when these waves travel down and bounce off a buried object, they are distorted. This distortion would then be measured at a second point by a detecting instrument. Geological prospectors who have used the seismic technique on a much larger scale, using explosives, have had high success in discovering new oil fields.

Preliminary seismic tests by Lerici at Sybaris and the Etruscan cemeteries show the technique is a "practical possibility."

Lerici also told me how conventional radar has been used in archeology. Not long ago one of his teams beamed radio waves into a wall of the monastery at Ravenna, Italy, and detected an unusually strong echo. The echo, they found, came from a beautiful section of iron grillwork hidden in the wall.

In medieval times monks under persecution buried their treasured objects in masonry walls to protect them from enemies. A century ago, monks repairing a wall at this same monastery found the bones of the great poet Dante Alighieri, who died there in 1321.

Also being developed is a modification of the electronic mine detector. The Army detectors can spot hunks of metal buried a foot or so below the surface. Archeologists need an instrument that will find metal buried three feet or more. In the near future, the Pennsylvanians plan to have one ready to search for Iron Age tombs (1500 B.C.) in Turkey.

Casting his eye to the future, Lerici told me that "sooner or later--perhaps in 20 to 50 years--we should be able to 'see' everything in the ground with nuclear radiation."

Everything in the world, he explained, gives off its own unique radiation, particularly if jolted first with a burst of

radioactivity from outside. Today nuclear physicists and chemists bombard materials in the lab with nuclear radiation, then study the "back scattering." So, said Lerici, "why not bombard likely sites and study the back scattering of buried ruins?" While this presents enormous technical problems, such as shielding and cost, he feels that as science advances, these will be overcome.

The archeologist of tomorrow, then, will be an expert on far more than history. He'll be a combination physicist-chemist who, with his new scientific tools, will be able to hunt down man's past with a speed that would leave shovel-turners and soil-sifters breathless.

The obvious remnants of the past--Egypt's pyramids, Rome's forum, Aztec ruins, Indian burial mounds--have been there for centuries for the taking. And in all instances grave robbers took first. There are just as many hidden remains, like Sybaris, which no man has seen or touched for thousands of years.

All over the world, said Dr. Rainey, there are "rich sedimentary plains at the mouths of rivers or along the sea where we may expect to find ancient settlements deeply buried beneath the silt. Conventional archeology, to a large extent, has bypassed these rich plains where we might expect to find some of the oldest and most developed cultural deposits because there is often no evidence of the remains visible upon the surface."

Thanks to Space Age science, more and more of these lost cities that hold vital keys to man's past are going to be found.

"These are just the first steps we are taking," said Dr. Rainey. "We're just trying to get started. The future holds astonishing new techniques that will lead to remarkable discoveries about antiquity."

-30-

11/archeology/berland

BOX

...Meanwhile, back in the lab...

Inside workers have about a 13-year-head start over diggers in using the far-out techniques of the Space Age in the archeology lab.

Archeology's first scientific leap forward came in 1949 when Dr. Willard F. Libby invented radiocarbon dating. By burning a sample of wood from an Egyptian tomb and measuring the radiation in the resulting soot, he showed he could tell how old that wood was. Radiocarbon dating is now used in archeology labs all over the world and can date organic objects up to 25,000 years old. 40,000 (EKR)

Magnetic dating is based on the fact that when pottery is fired it becomes many fold more magnetic. Part of the earth's magnetic field is "frozen" into it. The earth's field changes a little every year. Records of this change have been kept since 1540, and changes before that can be computed. Sensitive instruments can measure the magnetic field in a vase and date it within 25 years.

Another dating technique is thermoluminescence. ~~Firing~~ clay also contains traces of radioactivity ~~creates crystal imperfections~~ that excite ~~trap~~ electrons. Reheating the pottery up to ~~350~~ 400° C. frees these electrons which cause the ceramic to glow even ~~brighter than~~ before they are red hot. The brightness of this extra glow can be measured. The older the pot, the more electrons have been trapped and the brighter the glow. Thermoluminescence can date objects as old as ~~a half~~ 5 of million years.

There are also obsidian dating (which relies on the fact that this volcanic glass absorbs a bit of water every year) and potassium-argon radiation dating.

There are also new lab methods of analyzing what an ancient object is made of.

In optical spectroscopy a tiny sample of a specimen is vaporized in an arc. Since each element burns with a characteristic color, analysis of the colors in the light reveals the specimen's composition.

In x-ray spectroscopy a specimen is bombarded with electrons to give off ~~x-rays~~ x-rays of various frequencies or "color." As little as a thousandth of a percent of any substance in the sample can be identified. This technique recently weeded out 18th century copies of ancient Chinese porcelains. The electron probe, a more delicate version, focuses a beam the size of this period . onto an object to ~~analyze~~ radiate it in layers; the x-rays emitted are then analyzed.

Bones are analyzed for fluorine, nitrogen, and acid content as a clue to climatic conditions in antiquity. Bones are also studied under the electron microscope. The hottest field in bone analysis is "paleoserology." Bits of the bone core are drilled out, crushed, and suspended in water. Then, by routine medical lab agglutination tests, the blood group (A, B, O, etc.) can be determined. Anthropologists are using this technique to trace the migrations of people across continents.

Lastly, electronic computers may be our new Rosetta stones. They are being turned to to help decipher ancient languages--such as Etruscan--which we ~~have~~ can not ~~decoded.~~ translate.

theodore berland / august 22, 1962

Arch Technology

Dear Dr. Rainey:

It was very nice meeting with and talking to you earlier this month. I'm enclosing a copy of the draft for an article in POPULAR MECHANICS based on my interviews with you and with Lerici. I'd appreciate your looking it over with the view to catching any factual inaccuracies that may have crept in. If I don't hear from you in a week (by Wednesday, Aug. 29), I'll assume it's all OK.

Thanks again for your cooperation. Incidentally, the two photos arrived.

Sincerely,

T. Berland

Pencil corrections made by EK Ralph 8/29/62

Dr. Forelich Rainey
THE UNIVERSITY MUSEUM
33rd & Spruce Streets
Philadelphia 4, Pa.

member
national association
of science writers
society of magazine writers

2840 berwyn ave.
chicago 25, ill.
longbeach 1-5398

theodore berland / august 30, 1962

Beth —
Is there anything you might suggest for chapter heads?
Thanks

Dear Dr. Rainey:

Thanks much for the photos you sent and for your call with the corrections for the ms.

Now, another request, which I hope doesn't tax your patience. Do you have a good photo or two showing exploration and excavation at Cerro de las Mesas? Also, can you tell me when work will start at Harper's Ferry and/or the Indian mounds of Michigan and can we have a pic or two of that work? Are there photos you can send of the thermoluminescence work (particularly of a pot glowing!) and any other lab techniques we mention? Lastly, are the projects at Petty and Texas Instr. far enough along that we might be able to get photos that show what they're doing?

These requests stem from two bases: we need more photos for greater variety to show every aspect of the article; since this will be published late in winter, we want to have the latest information in it. If something is happening then, that could be our "news peg."

Thanks again for your cooperation, and kindest regards.

Sincerely,

Ted Berland

Popular Mechanics
Blk & wh.

member
national association
of science writers
society of magazine writers

2840 berwyn ave.
chicago 25, ill.
longbeach 1-5398

October 2, 1962

h
Mr. Theodore Berland
2840 Berwyn Avenue
Chicago 25, Illinois

Dear Mr. Berland:

Elizabeth Ralph has just sent to you some pictures of the work with instruments in Mexico and I regret that there has been such a delay in getting these to you. As a matter of fact we could not find them.

Pritchard did not use any instruments at Jordan but I feel sure we will be using some there before very long.

Beth Ralph is also sending you some photographs of work at Harpers Ferry done this summer where we succeeded in locating an old rifle factory. That is about it.

Regards,

Froelich Rainey
Director

FR:ad

theodore berland / september 26, 1962

Dear Dr. Rainey:

I assume I haven't heard from you on my August 30 letter because you've been away. I hope this gets you between trips. Let me add to my inquiries of last month a new one, about the excavation in Jordon, el-Jib. I heard about this through a release issued by Science Service. If Pritchard used any of the new techniques, perhaps his work is the "peg" we are looking for. If so, any additional information and photos you can supply?

Hoping to hear from you soon.

Regards,

TB Berland

Dr. Froelich Rainey
THE UNIVERSITY MUSEUM
33rd & Spruce Streets
Philadelpgia 4, Pa.

member,
national association
of science writers

2840 berwyn ave.
chicago 25, ill.
longbeach 1-5398

September 26, 1962

Mr. Theodore Berland
2840 Berwyn Avenue,
Chicago 25, Ill.

Dear Mr. Berland:

Dr. Rainey has asked me to collect some of the photos which you requested in your letter of August 30, 1962.

I have written brief descriptions on the backs of each. In explanation of the symbols used, ASCA stands for Applied Science Center for Archaeology which is the name we have given to the new projects which Dr. Rainey has initiated - instruments, lab techniques, etc. These are supported mostly by NSF (National Science Foundation) grants. The C^{14} labs (supported by Univ. of Penna., except for additional NSF grant) has been in existence for 11 years, but we consider it now as part of ASCA.

At the request of Dr. John Cotter and Mr. Edward Larrabee, initial instrument surveys were performed this summer by Hamilton Carson (ASCA student assistant) at Harper's Ferry. I imagine that you are acquainted with the previous work and subsequent excavations which Mr. Larrabee has conducted there.

I doubt that Petty and Texas Instruments are far enough along for photos to be available. If these are not needed immediately, could this be postponed until Dr. Rainey visits them at the end of October?

If you need more photos of instruments in action, I could send ones of resistivity, proton magnetometer and sonic prototype (the last built for us by MacLaughlin Electronics, Perkiomenville, Pa.) in use and trials this spring at Sybaris, Italy.

Sincerely yours,

Elizabeth K. Ralph

EKR/deh
Encl.

theodore berland / october 1, 1962

Ralph – I wrote saying no instrument used at Gibeon

Dear Dr. Ralph:

Thank you very much for the photos. I have sent them on to Popular Mechanics.

Yes, I would still like a picture of a sonic instrument, either of the prototype or of the one being used by Petty and Texas. We could probably wait until the end of the month, but if you have one ready now, why don't you send it along to:

Pritchard will send on address if you think necessary JBP

I'll send this, Beth

John A. Linkletter
POPULAR MECHANICS
575 Lexington Ave.
New York 22, N.Y.

Also, I asked Dr. Rainey about what equipment was used at el-Jib, Jordan. We'd like a pic of some of the new instruments were used there, since this is probably the most current expedition. Also, we'd like some more information about this expedition.

Who should do this?

Thanks very much for your cooperation.

Sincerely,

T. Berland

Dr. Elizabeth Ralph
Applied Sci. Ctr for Arch.
33rd & Spruce Streets
Philadelphia 4, Pa.

member
national association
of science writers
society of magazine writers

2840 berwyn ave.
chicago 25, ill.
longbeach 1-5398

INSTITUTE OF APPLIED SCIENCE OF VICTORIA

Science Museum — Planetarium — Observatory — Radiocarbon Dating Laboratory

ESTABLISHED 1870

Radiocarbon Dating Laboratory
304-328 SWANSTON STREET
MELBOURNE, C.1
VICTORIA, AUSTRALIA

DIRECTOR: R. H. FOWLER, M.AGR.SC.
TELEPHONE: 32 4811
IN REPLY PLEASE QUOTE:

8th. March, 1969

Miss E.K.Ralph,
Department of Physics,
University of Pennsylvania,
Philadelphia, Pennsylvania 19104,
U.S.A.

Dear Beth,

Well ! Hello !

I leave towards the end of the month on a brief racing study tour, States, Europe and U.K. in that order. I should be in the eastern U.S. at the beginning of May, leaving for Europe after the first or second week of the month. Would you send me a note telling me where you are likely to be ? I will be very disappointed if I don't see you and I'm hoping that I will catch up with you in Europe somewhere if you are not in Philadelphia.

The main purpose of the trip is to see what's being done and with what before expanding the equipment here, so I am specially interested in newer equipment, counters and so on. Have you made any major changes in recent years? Any lab you can think of that I should not miss ?

I do hope we can meet for a while somewhere !

Yours sincerely,

Anne

(A.Bermingham)

April 8, 1969

Miss A. Bermingham
Radiocarbon Dating Laboratory
Institute of Applied Science of Victoria
304-328 Swanston Street
Melbourne, C.1
Victoria, Australia

Dear Anne:

It was good to hear from you again. Please excuse the delay in replying, but I just returned from the jungles of Mexico.

I expect to be here in the first week of May, and then plan to leave for Italy - to a variety of sites there. Hope that you can visit us here. Our equipment is pretty much the same. Bob Stuckenrath is now at the Smithsonian in Washington, D.C. and is using urethane successfully. You might want to visit his lab. For up-to-date apparatus, I imagine that Isotopes, Inc. would be the best lab to see.

I am looking forward to seeing you.

Sincerely yours,

EKR:pc

E.K. Ralph

February 19th, 1974

Miss Anne Bermingham
23 Walstab Street
East Brighton
Victoria
Australia

Dear Anne,

Many thanks for your letter of 27th December. I was sorry to hear about the closing of your lab, especially, when you had been awarded a grant. Fortunately, our basic support comes from the University so that we are not in serious trouble.

We still have our two CO_2 counters, but have added a liquid scintillation spectrometer and benzene train. We are so unhappy, however, about making benzene and its associated problems that we are thinking of abandoning it and instead building a very good small CO_2 counter.

From time to time, I go abroad to do magnetometer surveys, but I have no specific plans until September when I am scheduled to go to Iran and Egypt.

MASCA Newsletter, vol. 8 had only one number - somehow or other we didn't publish two. I think the main reason was that it took us more time to prepare vol. 9, no. 1 than we had anticipated.

With best regards,

Elizabeth K. Ralph

Turd Hill
27th Dec. 1973.

Dear Beth,

I was sent to the Rome-Venice conference ("Nuclear Methods ... etc") this year and was highly delighted when Ed Sayre said he thought you'd be there — something I hadn't anticipated — but no! Wasn't a bad conference either, and a lovely setting in a lovely time of the year.

My lab. was closed down a couple of years ago, after I got back in 1969 + just after I had got a big + prestigious research grant (part of the trouble — there was a bit of competition for it which helped to close me up). It was a great disappointment to me, especially as I had finally seen my way to enter equipment + staff. The way we'd been going on was hopeless. The whole thing caused a great deal of unpleasantness + acrimony + I am still waiting to be found another post here, going mad with boredom + frustration! I went overseas late last year to the conservation conference + again in June this

TO OPEN SLIT HERE FIRST

Christmas 1973

AEROGRAMME
BY AIR MAIL * PAR AVION

Personal

Miss E. K. Ralph,
Associate Director,
Applied Science Center for Archaeology
The Univ. Museum, U. of Penn.,
33rd & Spruce Streets,
PHILADELPHIA, Pa 19174, U.S.A.
COUNTRY OF DESTINATION

SENDER'S NAME AND ADDRESS
R. Bermingham
23 Walstab Street,
East Brighton,
Victoria
AUSTRALIA POSTCODE 3187

FOLD FLAPS BEFORE MOISTENING GUM FOR

year, which broke things up a bit. I think this is the field I will finish up in (conservation of cultural material) if it takes off here.

Try & find time to write to me briefly & tell me what you are doing at present.

Also, can you tell me whether MASCA Newsletter volume 8 had only one number? They are awfully good you know.

Scarcely room for my first intention — to wish you a happy 1974 ...

December 11, 1969

Dear Dr. Bernal:

I have just been talking with Mike Coe on the telephone and understand that he has been talking with you about a continuation of our experiment at San Lorenzo. As you know, I really would like to complete this job and can arrange for the instruments and the operators for February and March in Mexico, if this is satisfactory with you. However, as I told Mike, one of our major problems last year was the absence of a really experienced archaeologist on the site, and hence I told Mike we would go ahead if he himself would get down there to instruct somebody personally on how to handle this experiment at San Lorenzo. Now Mike tells me he will do this but can't remain there, so that he is depending upon an archaeologist in Mexico to continue for the duration of the survey.

Therefore, I suppose this depends on who you can find to handle the job. We, of course, will handle the cost of the operators and the instruments and so forth, and I wonder if you can handle the costs of the actual workmen to excavate monuments. If not, do let me know and I will see what we can do about this also.

In any case, we hope that you will be able to find the right personaand will expect to carry on in February and March. Do let me know as soon as you find the right person.

We also have a request from Betty Bell to try out the cesium magnetometer in Guadalajara where she will be working this winter. I told her on the phone that if this was satisfactory with the Instituto in Mexico and if our plans worked out in San Lorenzo I felt certain we could get our operators and the instruments over there to work a few days with her just to see if the area is practical for magnetometers. Then if so we could do a more thorough job later on.

All the best,

Froeli ch Rainey
Director

Dr. Ignacio Bernal
Instituto Nacional de
Antropologia
Cordoba 45, Mexico 7, D.F.

Bernard Price Institute of Geophysical Research

University of the Witwatersrand, Johannesburg

1 Jan Smuts Avenue, Johannesburg 2001 South Africa
Telephone 724-3659, Telegrams 'BPI University'

7th November 1974

Dr. Elizabeth K. Ralph,
The University Museum,
University of Pennsylvania,
33rd & Spruce Streets,
PHILADELPHIA,
Pennsylvania 19174
U.S.A.

Dear Beth,

I recently received your MASCA newsletter and was very interested in the article by Gary Carriveau.

The Archaeology Department here are very interested in establishing ages for a number of settlement areas. They contacted me some time ago on the possibility of archaeomagnetic dating. I'm doing very little palaeomagnetism (I use the lab. in Salisbury about once a year). I was pessimistic about reliable magnetic dating anyway, because of the presence of large amounts of slag which could have distorted the magnetic field in the vicinity of the burnt clay remains. I suggested thermoluminescent dating but told them that the method was somewhat tentative. How, having read Carriveau's article, I'm more optimistic.

Revil Mason, the head of the Archaeology Department here, will include a description of the sites and slag material available. Would you perhaps be interested in doing thermoluminescent dating on this material?

For the past few years I've been doing magnetic and seismic surveying in the Indian Ocean. I've mainly been working between Marion Island and Madagascar and at present I'm writing up my data on the separation of Madagascar from Antarctica.

I'm hoping to attend next year's meeting of the American Geophysical Union in Washington. If so I certainly would like to visit you and Fro in Philadelphia.

My very best regards to both of you.

Yours sincerely,

Hugh

HUGH BERGH

November 21, 1974

Dr. Hugh Bergh
Bernard Price Institute of Geophysical Research
University of Witwatersrand
1 Jan Smuts Avenue
Johannesburg, 2001
South Africa

Dear Hugh:

Many thanks for your letter of November 7th. It was good to hear from you.

Since the time of publication of the MASCA letter, Gary Carriveau has left us. Mark Han and I have studied some of his slag data, and we are much less confident about the TL dates than he was. The natural TL light outputs were so small that we would consider them to be unmeasurable. We feel that more experiments need to be conducted, especially attempts to separate the crystal inclusions.

Quite frankly, with the shortage of funds and consequently of personnel in our labs this your, we do not have the time to continue these experiments at the moment.

In case Carriveau is interested, his address it: Dept. of Physics, Brookhaven National Laboratory, Upton, L.I., N.Y. 11973. If you mention any one from here, cite Fro Rainey because Carriveau and I had a battle-royal.

Fro and I hope that you will visit us next year. My guest house is still available except in mid-winter when I drain it to save oi.

With best regards,

Elizabeth K. Ralph

P.S. Reprint enclosed

BETA ANALYTIC INC.

RADIOCARBON DATING, STABLE ISOTOPE RATIOS, THERMOLUMINESCENCE, X-RAY DIFFRACTION
UNIVERSITY BRANCH · P.O. BOX 248113 · CORAL GABLES, FLORIDA 33124 · (305) 823-1441

Dear Colleague:

Just a note to let you know that a new commercial radiocarbon dating laboratory exists called BETA ANALYTIC INC. It's competitive in price and precision, and importantly, has the facilities to provide a prompt turn-around time. We're now getting out the dates in less than a month after receiving the samples.

This is a service venture recently initiated by Murry Tamers and myself. We thought long and hard before deciding to make the considerable financial investment necessary to do this properly. The experience of many years in our academic labs was one of constant requests from a wide variety of researchers in need of dates in their projects. Unfortunately, it just wasn't possible to help significantly with the volume of outside samples and still maintain our own research programs. We're sure that you have experienced similar problems.

Therefore, when you receive requests for radiocarbon dating services that you haven't the time or inclination to do, we would very much appreciate it if you could recommend our service. Most radiocarbon dating people know both of us personally during our many years of research and development in this field and can be confident of the quality and reliability of our measurements.

Thanks in advance.

Sincerely,

Jerry Stipp

Jerry J. Stipp, Ph.D.
President

JJS/se

Elizabeth — missed you at Bern. Hope you had a white Xmas. Best regards

UNIVERSITY of PENNSYLVANIA

PHILADELPHIA 19104

The College

DEPARTMENT OF ANTHROPOLOGY
University Museum
33rd and Spruce Streets

[BERNICE...?]

12 May

Beth -

have just had reply from Leslie Alcock re. South Cadbury survey etc. I must answer him before I leave on Wednesday (17 May), so am keeping his original letter.

In essence, he says that they now have (Martin Aitken, I suppose) results of 4 different-type instrumental surveys, & are having enough trouble & time evaluating these for the moment ! They have covered less than 30% of the site, so far, though.

He seems to think that the caesium mag. survey would be a bit too much just now, therefore. But he's still interested, and asks if you would like to visit there while they are digging - presumably with a view to doing a survey later on. They excavation dates are 15 July - 26 August. His address:

L. Alcock Esq., M.A.,F.S.A.
Dept. of Archaeology
University College
Cathays Park
Cardiff
Wales

He points out that, if you were able to visit while the dig was on, you would be able to see the various stratigraphies at different parts of the site, and the bedrock.

In case I don't happen to see you before I leave, I might mention that I shall be visiting Cadbury myself about 1/2 August or thereabouts, on my way down to Cornwall from Oxford - consequently I could take you there if we could arrange things in advance.
Home address for summer (will be away on & off, so

reply won't necessarily be instantaneous, I'm afraid);

Wailes
"Dogwood"
St Mawgan
Newquay
Cornwall

(Tel: St Mawgan 267)

Bernard

July 29, 1965

Dr. Jacob Bigeleisen
Brookhaven National Laboratories
Upton, Long Island, New York

Dear Dr. Bigeleisen:

In the course of studies of the changes in C^{14}, C^{13}, and C^{12} ratios due to natural fractionation, I wrote to Dr. William H. Stevens at Chalk River. Dr. Stevens kindly sent me reprints of several of his publications on the subject, and also mentioned that you have done work more recently in this field.

May I trouble you for reprints or references to your recent work? As mentioned in the enclosed reprint, we are measuring C^{13}-C^{12} ratios as a means of determining natural and/or processing fractionation. We then assume that the effect is double for C^{14}/C^{12}. The question is, is it?

Sincerely yours,

Elizabeth K. Ralph

EKR/deh

Encl.

February 7, 1962

Dr. Junius B. Bird
Museum of Natural History
New York City, N. Y.

Dear Dr. Bird:

I enjoyed reading your article entitled "B.P.: Before Present, or Bad Policy?" which appeared in American Antiquity, vol. 26, no. 4, and should appreciate it if you will send me a reprint, if available.

I hope that all of the C-14 people will read it. The ones with geological backgrounds don't seem to understand the problems and the accuracy required for archaeological dating, let alone the confusion that B.P.'s cause in publications.

Sincerely yours,

Elizabeth K. Ralph
Research Associate

EKR/deh

COPY

(interviewed 9/20/74
Husband's no. = 4845
FB

Name: Diane L. Bishop
123 Walker Lane
Wallingford, Pennsylvania 19086
215-565-0154

Born: August 24, 1952

Marital Status: Married; no children

Education:

A. High School

Attended Hempfield Area Senior High School, Greensburg, Pennsylvania, where I studied advanced courses in the college preparatory program. I was graduated in 1970 with an A average, and was in the top 2% of my class of 750. While in high school, I was active in the American Field Service and the Pep Club; was corporate secretary of a Junior Achievement corporation; was feature editor of the school paper and won the Quill and Scroll award for high school journalism; and was treasurer of our chapter of the National Honor Society.

B. College

Attended the University of Pennsylvania in Philadelphia, Pennsylvania, and majored in Anthropology, with a specialization in archaeology. I also concentrated my studies in the areas of history, art history, and religious thought. I was graduated in May, 1974, with a Bachelor of Arts degree and an overall average of B.

While attending the University, I worked on an independent study program in archaeology for two semesters. I constructed a typology of projectile points from a prehistoric Indian site, developing my powers of observation, classification, and description. Later, I did a petrographic analysis of ceramic sherds from the same site, utilizing extensive laboratory methods and the technique of X-ray diffraction.

In addition, I participated in the Newman Club, a religious organization, as the organizer of its social activities. I was a member of the Kite and Key Society, a service organization to the University, serving as chairman of the Meet A Penn Student committee. In this capacity I organized and participated in the

counseling of the University's prospective freshmen. I also served as a freshman advisor, helping first-year students with social, academic, and personal problems.

Work Experience:

Summer 1970:

Worked as an au pair girl, living with a family and taking care of their children.

January 1971, Summer 1971:

Worked as an inventory clerk in Troutmann's department store, Greensburg, Pennsylvania.

September 1971 - September 1972, January 1973:

Worked for Dr. Solomon H. Katz, Professor of Physical Anthropology, University of Pennsylvania, on one phase of his research project. I researched and compiled a genealogy of an Alaskan village and developed a system for coding the genealogy for computer.

Interests:

Archaeology, general anthropology, history, art, sports, furniture restoration.

3:30 Children's Hosp. Today
Growth Ctr.

References:

Dr. Solomon H. Katz
University Museum
33rd & Spruce Streets
Philadelphia, Pennsylvania 19174

Mr. Kenneth Leh
Princeton Road
Sanatoga, Pennsylvania 19471

Mr. Lawrence Polsky
37 Windihill Road
Greensburg, Pennsylvania 15601

Mr. Louis T. Hughes
3512 Baring Street
Philadelphia, Penna. 19104

April 1967

To: The Metallurgy-Archaeology Committee
Miss E. Ralph

From: Mrs. Judith Kingston Bjorkman -- Progress Report

Since last fall's meeting, I have continued with diversified reading on the practical, archaeological, and philological aspects of metallurgy, to amass as many resources as possible before attempting to write on a specific area. I plan to continue this general reading until the summer, during which time I will write a Master's thesis on a specific topic. Some tentative (and still-too-broad) ideas which I have for this are:

(1) the metalworker in the Ancient Near East--social status, functions, names (according to historical periods), tools, etc.

(2) adjectives applied to metals in OA, MA, and MB times, especially those used in the metals trade between Mesopotamia and Anatolia.

(3) literary (i.e., belles-lettres) references to metals and weapons, especially their fabrication.

(4) metal jewelry--types and fabrication.

Part of the success of investigating a particular topic lies in the amount and type of tablets which have actually been found and are available. For example, there are a relatively large number of tablets from the periods mentioned in topic no. 2 above, dealing with trade in metals.

The immediate thrust of my current reading is to finish making file cards of all references to metals in the Chicago Assyrian Dictionary (I am about 2/3 finished), and Limet's, Le travail du metal au pays de Sumer. I have bought and am reading a microfilm copy of C. Hillen's 1955 doctoral dissertation

(University of Chicago), The Early Development of Metal-Working in the Ancient Near East (it is primarily archaeological). If anyone wishes to borrow it for a short while, they are welcome -- perhaps the Library should have a copy. Other articles and parts of books which I have read are too varied to mention here. I have taken notes of everything which I have read.

Judy Bjorkman

11

Box 66
Glen Moore, Pa. 19343
July 1, 1968

Dear Miss Ralph:

If you need any more information for the report please let me know. The outline of the contents of the thesis will be slightly different from what I gave you earlier, but the general idea is the same.

My thesis will be about 200 pages (!) in length. Parts of it are finished — if you would like a short section as a sample of the contents, I could type up a few pages for you. I am very fortunate in that Dr. A. Leo Oppenheim at the Oriental Institute in the University of Chicago has consented to read my thesis

and offer suggestions on it — this may slow up its ultimate completion (typing) somewhat, but I don't know for how long. Does this make any difference to you?

I will be in the Museum on and off until the end of July, when we are moving to Syracuse, N.Y. Can I still plan on having copies of my thesis xeroxed at the Museum?

I trust I will see you in the Museum.

Yours sincerely,
Judy Bjorkman

TO: Dr. E. Ralph
FROM: Judy Bjorkman
RE: Metallurgy-Archaeology Project --Cuneiform Documents

The work referred to in earlier reports has been continued. Collection of data for the M. A. thesis has been completed; about two-thirds of the thesis has been written. When it is finished in the coming weeks, a copy will be given to you.

Suggestions for further studies are included on the following page.

(Mrs.) Judith K. Bjorkman
July 1, 1968.

Miss Ralph

METALLURGY-ARCHAEOLOGY COMMITTEE
Cuneiform Documents -- Progress Report

To become acquainted with the most recent translations of the hundreds of cuneiform texts dealing with metals (and the lesser number dealing with metalworking), I have thus far read and made note-cards of every reference to metals in 7 of the 9 volumes of the Chicago Assyrian Dictionary. I will complete the last two, and when the newly-published tenth volume is available, I will make cards from it. Thus far I have made approximately 5000 cards, most of them from the CAD, 700 of them from the CAD Files in Chicago, and 200 from other reading. I have read and made personal notes on at least 11 books, 3 theses, and 60 articles or parts of books. These notes are being used in the development of my Master's thesis. I am continuing my reading and am writing the first chapter of the thesis. At this time, a rough, tentative structure of the body of the thesis is as follows:

Ch. I — The beginnings of metalworking--archaeological evidence

Ch. II — Smiths and metalworkers in Sumerian and Akkadian "belles-lettres"

Ch. III — Smiths and metalworkers in the earliest texts (down to Ur III)
--the gods of the smiths
--conclusions

I plan to finish this spring.

(Mrs.) Judith Kingston Bjorkman
February 28, 1968

1-942-2879

not Fridays

Subject: Metallurgy-Archaeology Project--Cuneiform Documents--Suggestions for Further Study

There are many areas of possible investigation open in the area of cuneiform documents. To mention a few:

(1) The whole area of metal jewelry--nomenclature, style, uses, etc.--is vast and nearly untouched.

(2) My thesis has not utilized all possible references to smiths and their work. Little of the first or second millennium material has been used, and the third-millennium texts have not been exhaustively covered.

(3) The meaning(s) of the various adjectives used with, and synonyms for, the metals needs to be studied.

(4) A specific problem is the meaning of the words for "copper" and "bronze" in the first millennium B. C., i.e., whether they have actually gotten reversed in meaning, or does another explanation make more sense?

(5) The forms in which metal was exchanged and used;

(6) Textual sources for geographical sources for metals and ores;

(7) A collection of metaphorical uses of the words for metals; (these last three areas are "shorter" topics).

In my contact with the archaeological material, the following archaeological investigations would seem to be of value:

(1) Study of the style of Near Eastern metal containers, etc., from the view of typology, especially in relation to influence of/from pottery and stone types.

(2)Analyses of natural clay from various areas (other than the Amouq) in the Near East, for purposes of determining the firingtemperature:sherd-appearance correlation.

(over)

Then, the type of furnaces/ovens and their temperature ranges can be determined for various periods.

(3) A cataloguing of Mesopotamian metal objects for the late third, second, and first millennia B. C.

(4) An on-the-spot study of the current metalcrafting in Iraq and Syria, before all of the older methods have died out. H. Wulff's book, The Traditional Crafts of Persia (M.I.T. Press; 1966) Chapter 1, is an example of the form this study might take.

(Mrs.) Judith K. Bjorkman
July 1, 1968

G. Bjorkman

PREFACE

This thesis sketches rough outlines of the place which metals and metalworkers held in the society and thinking of the Mesopotamian people. The concentration is on third-millennium textual material, but second- and first-millennium references have also been used. In Chapter I, to deal with the period before the beginning of comprehensible textual evidence, I have collected references to metal artifacts from around the ancient Near East, down to about 2500 B. C.; some conclusions from this archaeological evidence are presented at the end of the chapter. Chapter II is primarily lexical, dealing first of all with words for the six major metals used in ancient Mesopotamia, and next with the five most frequently-occurring professional designations for metalworkers or groups of craftsmen. Chapter III has three parts, each of which is intended to contribute to a general picture of Mesopotamian attitudes toward metals and metalworkers. Part 1 is a collection of lists of metals; Part 2 is a collection of references meant to illustrate the nature of any relation of metals and metalworkers to magic and religion; Part 3 is a collection of literary ("belles-lettres") references to metalworkers. The Appendix is primarily a presentation of several aspects of practical metallurgy, which should be kept in

mind when attempting to say something about metalworkers and their craft. In this thesis, I make no real distinction among the phrases, "smith," "metalworker," "craftsman," and "artisan." They are used interchangeably.

One of my intentions is that this thesis be used by archaeologists and anthropologists, to furnish them with an idea of the nature and complexity of the philology of an area which has been dealt with mainly by archaeologists (e.g. Sir Leonard Woolley), anthropologists (e.g. V. Gordon Childe) and engineers (e.g. R. J. Forbes). B. Landsberger, H. Limet, and D. Weisberg are almost the only philologists who have dealt at some length with the subject of Mesopotamian metals and/or metalworkers.

This thesis is very broad, perhaps too broad, in its scope, and it raises many more questions than it answers. However, I hope that anyone who deals with the real questions in this area will enjoy studying the field as much as I have.

I wish to add a few miscellaneous remarks: (1) specific permission to use the analyses from Tepe Hissar (Chapter I, Part 2, footnote 311) and one from Tepe Gawra (Ch. I, Part 2, footnote 110) is still pending. I have not yet heard from Dr. Junghans. (2) There is no absolute uniformity to my system of transliteration of the cuneiform texts. Most often, I have simply copied the system used by the particular scholar who made the translitération. Quite arbitrarily, I have not included

transliterations whenever I felt that they would not add to the sense of the point under discussion. (3) References to the Chicago Assyrian Dictionary are almost always followed by the exact primary reference(s) given in the CAD. I have usually not enclosed these in quotation marks. (4) All of the nearly 6,000 cards which I have made concerning metals and metalworking, from the CAD material, are filed in the University Museum in Philadelphia. If anyone wishes to use them, they may contact Professor Å. W. Sjöberg there.

I am extremely grateful to Dr. S. N. Kramer, who directed me to this area of research by giving me a grant for this purpose. Dr. Kramer also suggested my method of research; I realize, in retrospect, that this was the most profitable method which I was capable of employing, viz., reading the entire Chicago Assyrian Dictionary, and making note-cards on each reference to metals and metalworkers. Dr. Kramer has always been a source of inspiration and encouragement, because of his never-failing sense of humor and his concern for his students.

This last can also be said of Dr. Å. W. Sjöberg, who has patiently answered hundreds of my little questions, and has furnished me with many ideas, translations, and references, not to mention drawing some of the signs given in this thesis. I only regret that I was living in Syracuse, N. Y., at the time of final writing of the thesis, and was only able to benefit from Dr. Sjöberg's

help on parts of its final form. I wish to thank Dr. R. H. Dyson, Jr., Curator of the Near Eastern Section of the University Museum, who gave generously of his time and resources to help me with the material in Chapter I.

I am grateful to the Government of the United States of America, who, through a National Science Foundation grant, made my work possible at all. This grant was mediated through the School of Metallurgy and Material Science at the University of Pennsylvania, and I wish to thank the Director of that School, Dr. R. Maddin, and his administrative assistant, Cmdr. P. Shumaker, for their continuing help and generosity. Similarly, I wish to thank Miss Elizabeth K. Ralph, Associate Director of the Applied Science Center for Archaeology at the University Museum, for her kind and unfailing help on administrative detail.

To the staff of the Chicago Assyrian Dictionary, especially Dr. A. L. Oppenheim, Dr. E. Reiner, and Dr. J. Renger, I wish to express my gratitude for the gracious and helpful way I was received on the two occasions I visited the Oriental Institute for research purposes. To Dr. A. L. Oppenheim goes particular appreciation for a critical reading of the finished thesis.

To my colleagues at the University Museum, I am grateful for help on numerous details. I wish to thank Mr. A. H. Al-fouadi, in particular, for his generous help with references and for drawing some of the cuneiform signs in the thesis.

Others who were very helpful are the following: Mr. John Witthoft, Research Associate, American Section of the University Museum, who helped me with several aspects of practical metallurgy; Dr. David Weisberg, of Hebrew Union College, who loaned me a copy of his dissertation, before it was available in book-form; and Mr. Stephen Feldman, who gave me numerous notes and references when he was a graduate student at the University of Chicago.

Finally, I am very grateful to my husband, Len, for his help, understanding, and great patience.

As I had occasion to note in a recent article in ETHNOLOGY (vol. 1, 1963, pp. 485-527), the ancient cuneiform documents available to the modern scholar, run into the thousands, and not a few of them are relevant in one way or another for the history and technology of metals and metallurgy. But to date except for a scattered article or monograph, very little has been done to collect and evaluate this widely diffused source material, since cuneiformists are usually not deeply interested in such every-day, mundane subjects. What I would like to do, therefore, is to put one or two of my students to collecting all the cuneiform contexts in which metals and metalworkers are mentioned in the translated cuneiform texts in order to lay the groundwork for a better understanding of ancient metallurgy. This is of course, a vast project, and it will take at least two years to complete it. A grant of $2000. per year for the next two years would make it possible to select the students qualified to do this work under my guidance.

Samuel Noah Kramer
Clark Research Professor of Assyriology
Curator of Tablet Collection

7/28/65

MORRIS BLACKBURN · 2104 SPRING STREET · PHILADELPHIA 3, PENNA.

Oct 10, 1960

Dr. Froelich Rainey, Director
University Museum
33rd & Spruce Sts
Phila. Pa -

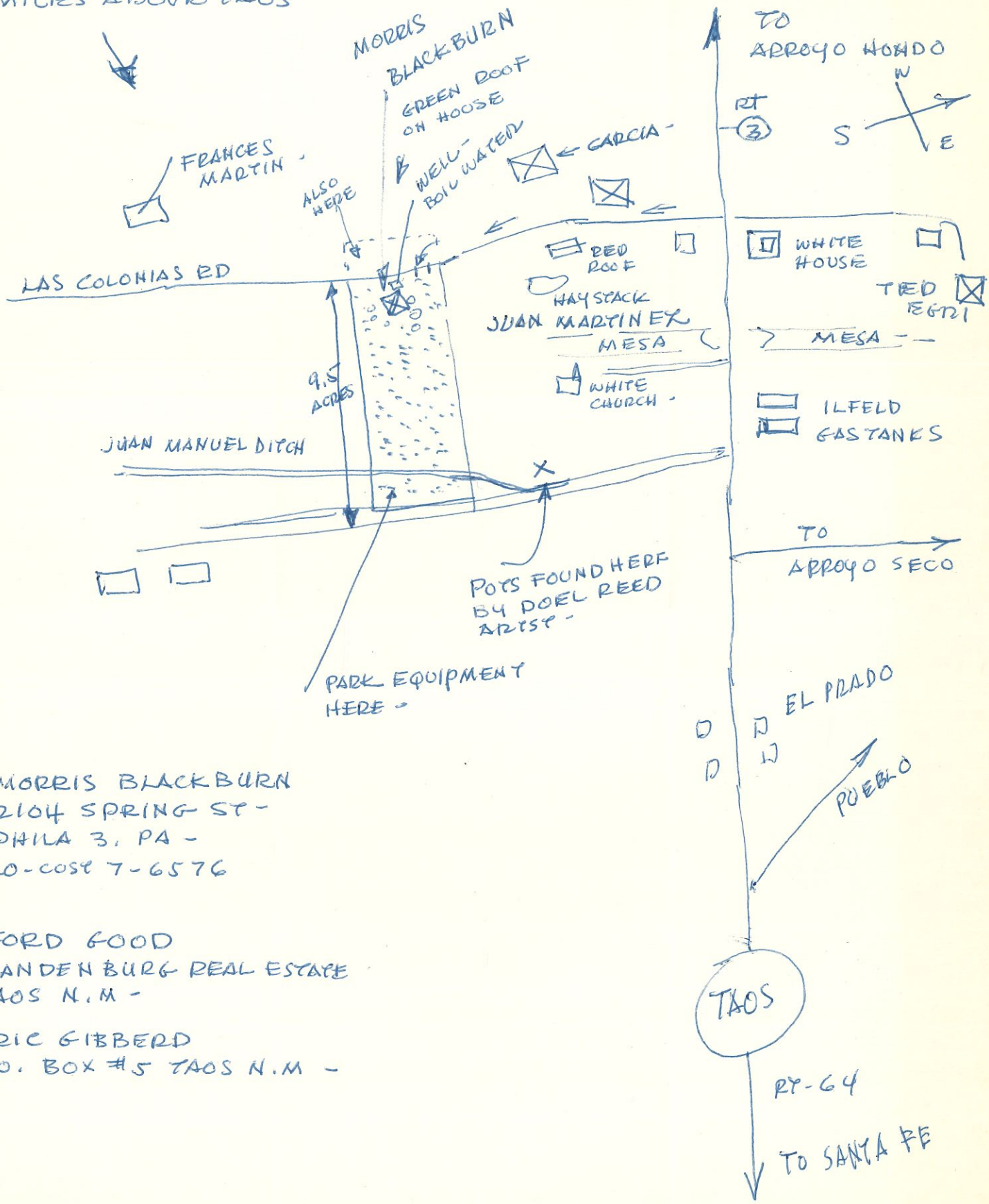
Dear Dr. Froelich:

Here is a crude map of our little place in Taos, New Mexico -
There are a number of things I should like to discuss with you and have some slides of the place which you might want to see -
There may even be some legal questions for our mutual protection and I should like to know the possible extent of the program and the specific use you will make of the land -
Also I have a number of artist friends out there who would be more than pleased, as I am, to help in any way possible. Also they could provide some social life for your crew -
Please let me know when and if you would like to discuss this with me -

cordially -
Morris Blackburn

(LO.7-6576 -)

LAS COLONIAS
SECTION ABOUT
5 MILES ABOVE TAOS



MORRIS BLACKBURN
2104 SPRING ST-
PHILA 3, PA -
LO-cost 7-6576

FORD GOOD
BRANDENBURG REAL ESTATE
TAOS N.M -

ERIC GIBBERD
P.O. BOX #5 TAOS N.M -

file
Archeol
Tech

October 13, 1960

Mr. Morris Blackburn
2104 Spring Street
Philadelphia 3, Pennsylvania

Dear Mr. Blackburn:

Many thanks for your note of the 10th with the map and your offer of land hospitality in New Mexico. As I probably indicated in our conversation, our young physicist is now working with Sun Oil Company and Texas Instrument Company trying to devise a new prospecting instrument, and with the best of luck he will be ready to test in February. At that time we will need a site somewhere in the Southwest to try out the new instrument, and we might then be extremely happy to have a region around Taos where we know something about the archaeology anyway. Of course I am an optimistic fellow, and it may be that by February we are still bogged down with electric circuits, tubes and transistors and by no means ready to try it in the field.

Anyway, I'll keep in touch with you, and whenever you have a chance, drop in here for a cup of coffee with me.

With best wishes,

Froelich Rainey
Director

FR:bh

January 4, 1963

COPY

Mr. Robert H. Riley, Jr.
Black & Decker Manufacturing Co.
Towson 4, Maryland

Dear Mr. Riley:

We appreciate very much your visiting our laboratories and making available to us your new half-inch drill and batteries.

Our first field test of the drill was scheduled for December 31st, and needless to say, we didn't stay out-of-doors very long. We did learn, however, that our first attempt at making core-boring bits wasn't successful. We shall try again and hope for a warmer day. The drill itself functioned well in spite of the cold.

Thank you too for the battery connector contacts which Mr. Colburn brought to us. I hope to find time next week to do some serious testing of the battery and the gradiometer. We plan to experiment with it too as the power source for a new transducer in connection with our sonic device.

I hope to have a more concrete report in the near future.

Sincerely yours,

Elizabeth K. Ralph

EKR/dh

August 16, 1974

Dear Ed:

I hope you had a good trip to London. We do indeed have a thermo-luminescence process here. It is somewhat new and very expensive, I am sorry to report that to do samples of pottery for non-academic institutions they have been charging $500. However, individuals such as your friend could make it as a contribution to the Museum for tax purposes. I hope this information will prove helpful and I look forward to seeing you soon.

As ever,

David Crownover
Executive Secretary

Mr. Edwin P. Rome
Blank, Rome, Klaus & Comisky
Four Penn Center Plaza
Philadelphia, Pennsylvania 19103

BLANK, ROME, KLAUS & COMISKY

LAW OFFICES
FOUR PENN CENTER PLAZA
PHILADELPHIA, PENNSYLVANIA 19103
215 LOCUST 9-3700 CABLE: BLARCOM TWX 710-670-1073

SAMUEL A. BLANK
OF COUNSEL

OUR FILE REFERENCE:

July 31, 1974

Mr. David Crownover
University Museum
33rd and Spruce Streets
Philadelphia, Pennsylvania

Dear David:

Recently when one of my colleagues was in Bogota, Colombia, he met Dr. Jaime Errazuriz, who is, I learn, a very important collector of pre-Colombian art. In the course of the conversation, inquiry was made by Dr. Errazuriz of a process called "Termoluminescence," used apparently in the dating of objects. The purpose of my letter is to inquire whether the Museum makes us of this process and has a facility capable of being made available to others. I guess in a way this is analogous to the discussions we have had recently with Bill Kohler relating to other kinds of facilities to be made available for the Museum and others.

Any information that you may provide me for transmittal to Dr. Errazuriz would be appreciated.

With kind regards,

Sincerely yours,

EDWIN P. ROME

EPR:vk

Henry -
for your information

January 7, 1975

Professor A.L. Bloom
Department of Geological Sciences
211 Kimball Hall
Cornell University
Ithaca, N.Y. 14853

Dear Professor Bloom:

Two copies of our MASCA Newsletter 9(1) are enclosed as well as the offprint with the pretty picture. In the Newsletter, the six plots are large enough to read, but in correcting C-14 dates, we ususlly use the tables that follow the figures.

These calibration curves were derived from a simple computer program, but we have not used one in reverse--namely to correct dates for samples of unknown age. We prefer the tables.

If you want blueprints of the six original plots, which measure 30 in. by 9ft.,,when glued together, we could send you copies. We would have to charge $30.00 for these, however.

Your sea-level study sounds like an excellent project.

Sincerely yours,

Elizabeth K. Ralph

CORNELL UNIVERSITY
ITHACA, N.Y. 14853

DEPARTMENT OF GEOLOGICAL SCIENCES

KIMBALL HALL
(607) 256-5267
-2377

December 30, 1974

Dr. E. K. Ralph
Museum Applied Science Center for Archeology
University Museum
University of Pennsylvania
Philadelphia, Pennsylvania 19174

Dear Dr. Ralph:

In your excellent review and calibration of the radiocarbon dating method (Amer. Scientist, Sept./Oct. 1974) you refer to a set of 6 large plots of your calibration curve (ref. 18; Ralph, Michael and Han, 1973, MASCA Newsletter 9(1).) I would like very much to have two copies of that reference, if they are still available. An offprint of the American Scientist article would be very convenient, as well.

From the enclosures, you will see that I am about to start a major compilation and evaluation of dates related to sea-level changes during the last 15,000 years. One problem will be to store information in a form that can be recovered and manipulated easily. Do you have a computer program for storing and converting radiocarbon ages to real ages? I think the study of sea level must be based on real time, for I expect to be incorporating tectonic rates that are derived by techniques other than radiocarbon dating.

I would appreciate any comments or recommendations about the sea-level project from you and your colleagues.

Sincerely,

A. L. Bloom
Associate Professor

ALB:hc

Encl: Working Program and Geotimes Report.

sea-level history to be studied

A major new international program has begun, aimed at compiling a worldwide history of sea-level changes during the last 15,000 years. One goal is to solve purely scientific problems of the geologic past; another is the serious applied problem of future changes of sea level and the effects on man and his works on the coastlines.

On Sept. 26-27 more than 20 scientists from 9 countries convened in Haarlem to prepare a preliminary working program and time schedule for the study of sea-level movements. The director of the Netherlands Geological Survey, A.A. Thiadens, was the host.

The meeting was one of 14 that have been held recently under the sponsorship of Unesco and the International Union of Geological Sciences to organize projects accepted by the Executive Board of the International Geological Correlation Program. Although Project Working Groups cannot be formally established until National IGCP Committees have indicated the intent of their countries to participate in specific projects, many of the provisional working groups are now at work. For the sea-level project, the meeting convenor and preliminary chairman of the working group is Arthur L. Bloom of the Department of Geological Sciences, Cornell University. The other members of the preliminary working group are J.C. Schofield, New Zealand Geological Survey; B.P. Hageman, Geological Survey of the Netherlands, and Horace G. Richards, Philadelphia Academy of Natural Sciences. Hageman is president of the Inqua Commission on the Holocene and Richards of the Inqua Shoreline Commission.

The sea-level project is planned to provide a unique working relation between Unesco, IUGS, and Inqua through members of the two Inqua Commissions and their regional subcommissions. Most scientists who study sea-level movements associated with the melting of the ice sheets during about the last 15,000 years are active in the Inqua Commissions. By using these people as sources of information, the working group of the sea-level project can quickly assemble reliable information about sea-level movements on the world's coasts.

The primary objective of the sea-level project is to establish a graph of the trend of mean sea level during the waning phase, or deglacial hemicycle, of the Wisconsin (Weichsel, Würm) glaciation. Because sea level has continued an upward trend of 5-10 m since the final melting of the North American and Fennoscandian ice sheets, other causes for the rise must be sought. Tectonic movements, isostatic readjustments of the Earth's outer layers, changes in water temperature and salinity, and changes in tidal dynamics have been suggested. No general agreement has been reached about the details of sea-level movements; scientific proponents support hypotheses of either smooth but decelerating rise, or oscillations related to Holocene climatic change. A compilation of all available reliable information about sea-level movements, computerized and retrievable in a variety of forms, should clarify the debated issues.

The IGCP sea-level project has a serious applied goal, as well. Millions of people live in low-lying coastal regions on deltas and coastal plains. Most of the field excursions held after the Haarlem conference were on terrain that is several meters below mean sea level. In the latest decade, the tide gauges of northeastern U.S. seaports have recorded a rise in mean sea level of about 10 cm. That trend is too local and anomalous to be accepted as a worldwide or long-term average, but it illustrates the hazards to coastal installations. When the hurricane track shifts toward the northeast Atlantic coast again, after a decade or more of dominantly Gulf Coast storms, the waves and tides will have an additional 10 cm of depth over which to flood. On low coasts, the loss of 10 cm freeboard can mean death and disaster for many thousands more people. Scientists cannot afford to study recent sea-level trends in an abstract sense.

It is possible that a shrinking West Antarctic ice sheet is providing the water for the continuing upward trend of sea level during recent millenniums. By current estimates, an additional 4 m of sea-level rise could occur over the next 6,000 years from this cause alone. Many international scientific projects, including CLIMAP, GARP, SCAR and the Geodynamics Project are now at work on projects that are related to sea level, but none are specifically concerned with the problem. The Working Group of the IGCP Sea Level Project hopes to coöperate fully with other scientists in exchanging information about climatic change, vertical crustal movements, and the history of ice sheets.

Sea level is a sensitive integrator of many variables. It also determines the limits of human occupancy, and the legal definitions of private ownership and government control. As it changes, especially as it rises, lives are threatened. The sea-level project was submitted to the Unesco-sponsored IGCP with a sober realization of responsible science.

Arthur L. Bloom
Department of Geological Sciences
211 Kimball Hall
Cornell University
Ithaca, N.Y., 14853

INTERNATIONAL GEOLOGICAL CORRELATION PROGRAMME

IUGS
UNESCO

SEA-LEVEL PROJECT

(IGCP PROPOSAL NO. 74/I/61, INCLUDING PROPOSAL NO. 73/I/9)

FULL TITLE: SEA-LEVEL MOVEMENTS DURING THE LAST DEGLACIAL HEMICYCLE (ABOUT 15,000 YEARS)

Preliminary Working Program and Schedule
(as discussed and amended at the preliminary meeting of a group of experts, Haarlem, Netherlands, September 26-27 , 1974)

November 5, 1974

by

Dr. Arthur L. Bloom
Department of Geological Sciences
211 Kimball Hall
Cornell University
Ithaca, New York 14853 U.S.A.
(Provisional Project Leader)

I. SCOPE OF THE PROJECT.

A. The primary objective is to establish a graph of the trend of mean sea level during the last deglacial hemicycle and continuing to the present time (about 15,000 years).

B. It is expected that the sea-level graph will be primarily an expression of the changing hydrologic balance between ice and water in response to climatic change. Individual records of sea level from many localities will be used to compile the graph. Differences among the local records must be accounted for by local crustal movements or changing tidal amplitude. Crustal movements may be interpreted as the result of tectonic processes or isostatic adjustments to shifting masses of ice and water.

C. Differences in local sea-level histories will be used to draw conclusions about the fundamental parameters of strength and elasticity of the earth's outer layers.

D. Future trends of sea-level movements will be predicted. In particular, predictions will be made for heavily populated, low-lying coastal regions where a relative rise of sea level poses especially serious human problems.

II. IMPLEMENTATION.

A. Compilation.

Data on a global scale are required. In order to compare local records, a standardized format is required.

1. All linear dimensions, including depths and elevations, must be reported in or converted to metric units.
2. Time should be reported in radiometric years. If not, the method of establishing age (varves, dendrochronology, pollen, archeology) must be explained.
3. Probable errors, involving factors such as compaction, must be assigned to linear and time dimensions. Reproducibility of data points must be established.
4. A description of the material or evidence used to establish sea-level change must be provided. A brief site description should be included.
5. A precise location for each site or sample must be recorded in latitude and longitude. In addition, a local coordinate system may be used, if desired.

6. The tidal datum used to determine height or depth must be recorded, and the method of establishing the local datum plane must be known. Actual tide range should be stated. Special hydrological conditions, such as might relate ground-water level to sea level, should be described.

7. All of the compiled data must be converted to a form suitable for computer storage and retrieval. A computer facility must be designated to provide services for the project.

8. Local sea-level curves may be established at suitable scales for local purposes. If so, standards as recommended by the 1969 report of the INQUA Commission on Quaternary Shorelines should be followed. Regional INQUA Subcommissions may also wish to standardize the tidal datum to be used in their regions.

B. New Research.

For many coastal areas, no information on sea-level changes is now available. Local experts must be encouraged to obtain the missing data.

1. National IGCP Committees will be urged to endorse research related to the sea-level project. National support for qualified researchers should be endorsed by the Project Working Group.

2. To normalize procedures, experts in the field of sea-level research should visit developing countries by invitation, and advise local experts in collection procedures, laboratory analyses, and interpretations.

C. Interpretation.

1. A group of experts on the project must meet at regular intervals, perhaps every two years, to review the compiled information, define the regions where new research should be encouraged, and discuss interpretations of the data. Alternate meetings of the group of experts should coincide with INQUA congresses.

2. Geophysicists, geodesists, hydrographers (tidal experts), and climatologists should be invited to participate in the interpretive phase, in addition to experts in sea-level research. Total agreement cannot be expected, but the compilation of available data and the acquisition of new data can be expected to stimulate new research on the mechanics of crustal movements and ice-sheet growth and shrinkage.

3. Finally, constructive interpretation may lead to new policies about human occupation of low-lying coastal regions.

D. Publications and Reports

1. An early objective of the Project Working Group, when established, will be a procedural guidebook or manual for collecting, analyzing, and interpreting evidence of sea-level changes. This manual will be based on examples from regions where advanced work has been done, but will be designed to guide researchers who have limited field experience or access to technical publications.

2. After an initial period of data collection and processing, preliminary reports will be prepared for review by the group of experts. Initially, such reports will attempt to synthesize and normalize data from regions where substantial information has been provided.

3. All reports, including a complete final publication, will be given wide distribution through appropriate channels. Procedures as set forth in Geological Correlation (no. 1, 1973, p. 28-29) and other Unesco-IUGS directives will be followed.

III. ADMINISTRATION.

A. In the project proposal accepted by the IGCP Board, the preliminary working group for the project consists of Dr. A.L. Bloom, Cornell University (provisional project leader); Ir. B.P. Hageman, Geological Survey of the Netherlands; and Dr. H.G. Richards, Philadelphia Academy of Natural Sciences. The IGCP Board also accepted and combined with this project another proposal submitted by Mr. J.C. Schofield, New Zealand Geological Survey. The preliminary working group has been expanded to include Mr. Schofield.

B. "When the countries participating in the project have been identified, the full Project Working Group will be established. It will elect its own Chairman, who may or may not be the project proposer." (extract from Geological Correlation, no. 2, Draft Copy of May 1974, p. 14-15).

C. To assist and advise the Project Working Group, a group of experts should be established. They should meet with the members of the Working Group (see II,C.1. above) at regular intervals. Members of the group of experts should be available to be invited to visit local projects and advise local scientists in regions where information is incomplete.

D. The INQUA Commission on Quaternary Shorelines and Commission on the Study of the Holocene, and the subcommissions of those commissions, include most of the world experts on sea-level movements. The presidents of the two commissions, H.G. Richards and B.P. Hageman, are members of the preliminary working group. Full use should be made of the facilities and organization of INQUA in coordinating project research. In particular, regional sub-commissions will be asked to compile and evaluate data from their regions. Information that has been collected for the Annotated Bibliography of Quaternary Shorelines (1965) and its later Supplements, and for the World Shorelines Map, will be used by the Project Working Group.

IV. COOPERATION.

The project is planned to continue for about 8 years. In order to move forward, closeliaison must be maintained between the Working Group, the committee of experts, and other national and international scientific programs. The following list is not intended to be inclusive, but illustrates the possibilities for cooperation.

A. Scientists participating in the International Decade of Ocean Exploration (IDOE), and the Geodynamics Program Committee on Recent Crustal Movement, are actively studying vertical crustal movements.

B. International research programs in Antarctica (SCAR) are defining the flow patterns in the largest ice sheet on earth and are learning the history of the Antarctic ice. Evidence has been offered that the West Antarctica ice sheet has lost volume equal to 3 m of sea-level rise in the last 5000 years, and may lose an additional 4 m of sea-level equivalent in the next 6000 years. Obviously, these ideas are of great significance to the sea-level project, and should be closely coordinated.

C. International climatology programs, including CLIMAP and GARP, are attempting to understand long-range climatic change. Projects now supported by these programs include compilation of present and past glacier-ice volumes, sea temperatures, and atmospheric circulation changes.

D. National hydrographic agencies such as the U.S. NOAA, maintain tide gauge records that should be integrated into the sea-level project. Experts on tides should be included in the committee of experts. Working Group no. 7 of the Inter-union Commission on Geodynamics has recommended the establishment of a global network of tide-gauge stations. Sea-level experts should support that project, and establish liaisonwithin their own countries with experts on tidal movements.

V. TENTATIVE WORK SCHEDULE

When established, the Working Group should follow the schedule in the project proposal, amended as follows:

Years 1-4: Compilation and computer storage of available global data.

Years 2-6: Determination of key areas with deficient data, and arranging for local experts to obtain the necessary data. Efforts will be made to expedite research in developing countries by arranging for laboratory support and field instruction for local experts.

Years 2-6: Mathematical modeling of trends and predictions; preliminary reports will be issued.

Years 6-8: Preparation of final report for publication.

-End of preliminary working program and schedule-

6915 Radnor Rd.
Bethesda, Md. 22234

20 July 1978

Dr. Elizabeth K. Ralph
Associate Director
University Museum
University of Pennsylvania
Philadelphia, Pa.

Dear Dr. Ralph:

Recently, I had the pleasure of reading Search For Sybaris and was intriqued, of course, by the problem of reaching the ruins of Sybaris. What work has been done in Sybaris since '69 is unknown to me and I am a complete layman on this subject. Nevertheless, I want to pass along to you some of my thoughts on the problem.

To be brief, it seems to me that, since the ruins are underwater in terms of the water table, their excavation must be an underwater excavation. What I would suggest is that a relatively isolated building located by magnetometer be approached by earthmoving equipment down to the water table followed by a combination of water pressure hoses and suction hoses to dissolve and remove silt. Mining hoses and underwater suction equipment is readily available. By so excavating a saucer-shaped hole, so that no side shoring is needed, the building and any artifacts could be exposed underwater by the techniques now used in marine archaeology. Plenty of clear water would apparently be available by surface pipes from the river in the Spring so that excavation could proceed rapidly and underwater visibility maintained for the divers. Or perhaps the abundant underground water itself could be used in the excavations.

Since Sybaris was buried by water then perhaps water can be used to uncover some of it. Water moved the silt and can move it again, leaving the ruins submerged in a shallow pond. Would you be kind enough to drop me a short note as to the feasibility of such a project—I am curious.

Sincerely,

Richard G. Board, M.D.

Richard Board, M.D.

Martin Biddle, Director

Richard G. Board, M.D.,
6915 Radnor Rd.,
Bethesda, Md. 22234.

27 July 1978

Dear Dr. Board:

We terminated our work in Sybaris in 1969. The Italian Department of Antiquities continued to excavate for a year or so, but I know nothing of their results.

On the Plain of Sybaris, the water table is 1 meter below the surface, and the Archaic city is at depths of 5 to 6 meters. Therefore, in excavations we first used pumps and finally well-point systems.

I am not familiar with water pressure and suction hoses, and therefore cannot evaluate whether or not they would work. At any rate, we are no longer concerned with Sybaris.

Sincerely yours,

Elizabeth K. Ralph.

213
787-0022

Rolph
ASCH

BODINE *Soundrive* COMPANY

LOS ANGELES, CALIFORNIA

MAIN OFFICE AND LABORATORY
7877 WOODLEY AVENUE
VAN NUYS, CALIFORNIA

March 31, 1967

Dr. Froelich Rainey
University of Pennsylvania
Philadelphia, Pennsylvania

Dear Dr. Rainey:

Our company specializes in sound wave sources, one major area of activity being in mechanical oscillators, for such uses as seismic surveying. A good example of one of our systems is shown in Patent No. 2,745,507, enclosed herewith.

During the course of development of our oscillators and their systems, we have occasion to build prototype small sized models, for this developmental work. As a result, we frequently find that we have a system, comprising practically a complete assembly, in model size, particularly in fairly small scale models. Sometimes these are used to study the ability to project a concentrated beam of low-energy sonics, so that the beam can be swept through the earth, with controlled directionality, as indicated in the enclosed patent. As soon as a project is completed, these models are usually just stored away.

The thought occurs that possibly some of these models could be used in archeological work. They produce a non-destructive, directionally controlled beam, which might be effective in locating archeological items. In this connection, some of these devices are adjustable in frequency, so that their definition can be adjusted in relation to the size of discontinuity being looked for in the earth. More importantly, these models operate at fairly high frequency, because of their small size, and therefore might be particularly suitable for shallow work such as in archeological field studies.

We have no thoughts of commercial aspects of these devices for archeological work. Our interest is mainly a matter of curiosity,

Dr. Froelich Rainey
University of Pennsylvania

March 31, 1967

wondering if these already developed devices might have some usefulness, such as in archeological survey work. In other words, we would be primarily interested in loaning out such a device, just to see, as a matter of scientific curiosity, if this might be of some particular use.

With this latter thought in mind, we are wondering if you could give us some comments. It would indeed be gratifying to our company to find that some of our model systems could be put to some limited use, rather than simply being stored away. Possibly this would be worthy of discussion sometime. Undoubtedly there are some amateur archeologists in our company who might get a kick in seeing this technique put to some special non-commercial purpose.

Very truly yours,

BODINE SOUNDRIVE COMPANY

A. G. Bodine, President

AGB:jef
Enclosure

April 8, 1967

Mr. A. G. Bodine, President
Bodine Soundrive Company
7877 Woodley Avenue
Van Nuys, California

Dear Mr. Bodine:

Dr. Rainey has asked me to reply to your kind letter of March 31st. We appreciate very much your generous suggestion that experiments in archaeological survey work be conducted with some of your prototype oscillators and systems.

You may have heard that we had been experimenting with a few sonic devices for archaeological prospecting. From our experiments with small standard portable seismographs, we thought that it was necessary to go to higher frequencies and consequently shorter wave lengths in order to detect the relatively small archaeological features, usually located at much less depth than bedrock and other geological changes. With this in mind, the Petty Company (San Antonia, Texas) did some experiments for us and found that 600 cycles was about the best frequency range for our purpose. However, even at this frequency the attenuation was so severe and our coupling so poor that we didn't succeed in penetrating the earth to a depth of more than 3 feet. We experimented with both continuous and pulsed oscillators, mostly acoustical types, but probably none was sufficiently powerful for our purposes.

After this we went off on another tangent and thought that we would retreat to a shotgun blast or dynamite as a source, and then select the higher frequency components for detection. For this purpose MacLaughlin Electronics (Perkiomenville, Pa.) designed and built a high speed 4-channel recorder and 4 special geophones, It was planned to test this system in collaboration with Dr. F. Romberg at Texas Instruments, but the recorder was never finished completely and did not work.

For the past year we have done nothing more. We continue to feel that there is a great need for a new mode of detection.for use at sites where magnetometers and resistivity methods are not suitable and also for greater depth penetration. The question is how to proceed.

Our test equipment, which may be of little or no use, is scattered here and in Texas. The other complication is that the best testing sites are in Italy, Greece, etc. In the U.S.A. it is difficult to find buried structural features covered with undisturbed earth. However, these minor difficulties are not insurmountable.

I plan to be in Los Angeles at the end of October, 1967 and would like very much to talk to you and possibly see some of your prototypes. This is a long time to wait, however, so perhaps you could suggest a quicker course of action.

Sincerely yours,

Elizabeth K. Ralph

EKR/gm

[1964]

Technique

June 13, 1963

Dear Mr. Boos:

I have yours of June 5, regarding your research in thermoluminescence and with oxygen content in sherds, and of course, we are very much interested since this is right down our alley.

You may know that our laboratory and that at Oxford are both working on the thermoluminescence technique and have recently gotten some encouraging results. The oxygen content business is completely new to me. We would be very happy to have results of Springer's work, and to collaborate with you in any way, on these techniques.

I expect to be here for six weeks now, and would be glad to talk with you either here or over the phone, if you have any ideas on collaboration in this business.

Very best wishes,

Froelich Rainey
Director

Mr. Frank H. Boos
45 Lakecrest Lane
Grosse Pointe Farms 36
Michigan

[BORTOLET]

212-724-7981

203 West 91 St., Apt. 2A
New York, N.Y. 10024

August 12, 1970

Dr. Elizabeth Ralph
Center for Applied Science
University Museum
33rd and Spruce Sts.
Philadelphia, Pa. 19104

Dear Dr. Ralph;

I am writing to you on the recommendation of the staff of the Archaeology Institute of America in New York.

I am presently a graduate student in physics at New York University and Goddard Institute for Space Studies, NASA, and, if things go well, should receive a Ph.D. in astrophysics in the coming year. I have been interested in archaeology for many years and would like to pursue as a career, some aspect of it that would utilize my background in physics. My most pertinent experience at the moment, I expect, would be my familiarity with many areas of scientific instrumentation. While my thesis research entails mainly atomic and molecular optical spectroscopy and computer programming, I also have experience in electronics, microwave and electron paramagnetic resonance spectroscopy, and various thermoanalytical methods.

From my reading, it appears that there is an expanding trend towards an interdisciplinary approach to archaeology; using physics, especially, in dating and survey work.

I feel that, given my interests and inclinations, any work I could do in archaeology would be more meaningful to me than the sort of work I would do if I remained entirely in physics.

Since you have been spoken of as a real pioneer in this area, I'm wondering if you could offer any suggestions as to how I could fit into the field. If convenient, I would very much like to come to Philadelphia and speak with you personally.

Thank you very much for your consideration.

Sincerely yours,

Victor J. Bortolot, Jr.

Victor J. Bortolot, Jr.

August 28, 1970

Mr. Victor J. Bortolot, Jr.
203 West 91 St,, Apt. 2A
New York, New York 10024

Dear Mr. Bortolot:

With your qualifications, I am sure that you could contribute to our MASCA projects, but at the moment we do not have funds for new positions.

I suspect that the financial situation will be bad again next year, but just in case it is not, we should be glad to talk to you and show you our laboratories. Sometime after Labor Day when vacations are over would be best.

Sincerely yours,

Elizabeth K. Ralph

EKR/ek

FRANK H. BOOS
45 LAKECREST LANE
GROSSE POINTE FARMS 36, MICHIGAN

June 5, 1964

Doctor Froelich Rainey
University Museum
University of Pennsylvania
Philadelphia, Pennsylvania

Dear Doctor Rainey:

Sharing your interest in the development of scientific techniques to determine the age of archaeological material, I had often thought that it was perhaps my duty to at least report what I had attempted. When I commenced to assemble my corpus of photographs of the Oaxacan Urns in the world's museums and collections, I became aware of the problem of falsification which has so distressed the directors and curators.

Connected with the Kresge Foundation as I was, I requested the Kresge Science Library to obtain for me all data available on techniques to determine the antiquity of ceramic material. I read all the papers there were in English, French and German and these put me in touch with scientists in England, Mexico, California and at the Massachusetts Institute of Technology.

At about this point, I communicated my interest in the technique of attempting to determine age by the measurement of the thermoluminescent glow curve to Dr. Ekholm, who rapidly absorbed my interest, and from then on the project became a joint one between us.

After a few false starts, Dr. Farrington Daniels of the University of Wisconsin undertook to assist us with these tests. Dr. Ekholm furnished a large number of samples of crushed ceramic material which he and I identified by code numbers and sent to Dr. Daniels.

The upshot was that in roughly one-third of the runs there were unexplained variances which left the tests inconclusive, but as to the other two-thirds, the tests were surprisingly accurate.

What we were doing became known to Dr. James B. Griffin and later to the Detroit Institute of Art and as a result, one Virgil Springer, a

scientist employed by the Detroit Testing Laboratory approached us with a claim that he had developed a technique to determine the age of ceramic material by measurement of the amount of oxygen the molecules of the material had re-absorbed since the original oxygen content had been burned out in the kiln. We spent nearly a year on this project while Springer attempted to perfect his technique. Again, Gordon Ekholm prepared carefully coded samples of ceramic material as did also Howard Leigh of Mitla. Three runs were made at various times. The results were not conclusive and were, in fact, contradictory. At about this time, Springer developed difficulties with his employer and unsuccessfully attempted to interest the General Motors technical staff in the commercial possibilities of his technique.

We are still seeking a cheap and accurate technique to determine this result without serious destruction of the piece, one within the limited budget of most museums.

I understand Mr. Thomas Yoseloff, a director of the University Press, plans to discuss with you a proposed publication on Oaxacan Urns in which we share an interest and which I have prepared.

If it would be appropriate, I would like to discuss this with you over the telephone and would appreciate a collect telephone call if and when convenient.

Incidentially, Gordon and I have the results of the Dr. Daniels' and Springer's tests, if they would be of interest to you.

Looking forward to the opportunity of meeting you (I am already acquainted with some of the staff of your museum), I beg to remain,

Sincerely,

Frank H. Boos

FRANK H. BOOS

FHB/das

203 West 91 St. Apt. 2A
New York, N.Y. 10024

September 29, 1970

Dr. Elizabeth K. Ralph
Museum Applied Science Center for Archaeology
The University Museum
University of Pennsylvania
33rd and Spruce Sts.
Philadelphia, Pa. 19104

Dear Dr. Ralph,

Thank you so much for the very pleasant and very interesting day my wife and I spent with you at MASCA two weeks ago. It was awfully generous of you to give us your time (and lunch) to explain what was being done by you and your colleagues. I was very impressed by it all; it reinforced my expectations of a body of work that was highly interesting, useful, and coherent.

My general exams and orals have been going on all this time (now finally over) so I haven't been able to do any thinking about new projects. I hope to see Junius Bird at the American Museum of Nateral History and some other people I've met there, and also try to talk with Edward Sayre, who is supposed to be at the Metropolitan Museum fairly often now. Maybe I can get some idea of things which need doing from them.

Again, I'd like to thank you and Dr. Winter and Mark Han for taking time out to talk with me and show us around.

Sincerely yours,

Victor Bortolot

Victor J. Bortolot

Jean BOUNOURE (chemistry Engineer)

18 rue de Nérac

64 000 - PAU

FRANCE

Pau, le 7 Décembre 1972

Jean

I had seen in "Chemical and Engineering NEWS" September 30, 1968, that you work on Archeology.

I want an advice, please.

I want to buy a modern instrument for detecting under the ground ancient coins (gold, silver, bronze, copper) (buried to 2 meters maximum).

I have seen that Magnetometers are available instruments.

Could you say to me, please:

- the Society which sells (name, complete adress)
- the names of the best instruments
- the approximative price.

In advance, I thank you very much for your informations.

Sincerely yours.

Bounoure

December 12, 1972

Mr. Jean Bounoure
18 rue de Nerac
64000 Pau, France

Dear Mr. Bounoure:

For detecting ancient coins, magnetometers are not suitable unless the coins are made of iron. Magnetometers detect changes in magnetic intensity.

However, if the coins are not buried deeply it is possible to use a metal detector. Several inexpensive ones are sold in the U.S.A. Ones that we have tried are made by the Edmund Scientific Company, 801 Edscorp Building, Barrington, New Jersey 08007. Their No. 2995 costs $30 in the U.S.A.

Sincerely yours,

Elizabeth K. Ralph

EKR/c

January 24, 1973

Mr. J. Bounoure
18 rue deNNerac
64000 Pau
France

Dear Mr. Bounoure:

As fau as I know, there is no commercial instumment that will detect small deposits of non-ferrous coins at depths of more than one meter.

The metal detectors designed for military use that are unclassified have no better sensitivity than the ones available commercially. However, about every ten years, the military designers do make improvements, but they are not available to the public for at least tten years. If you know some one in the right department in your Army, you might inquire.

When you receive the information from Edmund Scientific Company, I suggest that the more expensive metal detectors will have slightly better depth penetration.

Under spparate cover, I am sending you a catalogue of Relco Industries (P. O. Box 10831, Houston, Texas 22018) metal detectors.

Sincerely yours,

Elizabeth K. Ralph

EKR/11

J. BOUNOURE
18 rue de Nérac
64 000 - PAU
FRANCE

Pau, le 16 Janvier 1973

Dear Mrs. RALPH

I thank you very much for your answer to my letter about detector for ancient coins.

I have written to Edmund Scientific Company about detector for ancient coins not buried deeply.

But I would like others informations:

I want also to buy a detector for ancient coins buried deeply, from about 2 feets to 7 feets (0,50 meters - 2 meters).
But, I want to detect only gold, silver, copper and not iron, because there is often iron in the ground.

Please, could you give me informations on such a detector (description and eventually seller, adress, price)?

In advance, I thank you for your answer.

Sincerely yours.

Bounoury

August 25, 1967

Mr. Thomas A. Bowen
315 West Ave.
Wayne, Pa. 19087

Dear Mr. Bowen:

Please accept my apologies for not having written sooner. Miss Ralph had only just returned from Italy, and is scheduled to go back August 31; so our days have been crammed full of urgent activities.

We are indebted to you for the timers. As soon as Mark Hahn returns from vacation the appropriate one will be put to very good use with the X-Ray apparatus.

If you pass the campus in your travels do stop and visit us again

Sincerely,

Barbara Lawn

BL:rb

November 14, 1968

Mr. Francis P. Bowles
Dept. of Anthropology
Peabody Museum
Harvard University
Cambridge, Massachusetts 02138

Dear Frank,

Last week I gave a lecture on the subject of archaeological prospecting. As a result, an electronics engineer has offered to work on our old gradiometer.

I am wondering if you still have it. If you do and if you are not doing anything with it, could you please send it back (collect) to the Museum.

At any rate, please let me know one way or another so that I can tell him whether or not it is available.

With best regards,

R/rs

Beth Ralph

Techniques

April 13, 1965

BOYER

Dear Mook:

As you have probably heard, the Guatemalan Government is now entirely supporting the Tikal Project, at the handsome figure of $117,000 a year, unless there is a revolution there this should go on until 1968. So we are no longer in difficulty about financing the Tikal Project.

However, we are in a bind with the Applied Science Center for Archaeology (ASCA). Our program for developing new scientific techniques both for land archaeology and undersea archaeology was to be financed by a very substantial grant from the Ford Foundation, and that was all approved when the Head of the Humanities Division was suddenly changed and now the whole thing is held up for further study in the Foundation. Hence, I am very anxious for some private contribution to keep this going pending a decision from the Foundation. We have gotten some help from some of our Board members, but I note we have not had a contribution from you since September, 1963, and I wonder if you could give us a hand in this "Techniques Program this year.

The two most exciting developments in this field are the development of a rubidium magnetometer which we borrowed from a space vehicle and jerry-rigged for texts at Sybaris. It proved to be one hundred times more sensitive than the proton magnetometer and could pick up archaeological structures more than five meters deep. We are now simplifying this for archaeological use and will eventually be using it on land and undersea.

The other thing which seems to be working out is the thermoluminescence method of dating pottery. Our Chinese boy, Mark Han, here in the laboratory, has now developed an ingenious system and he has about six samples of sherds of known age which fall beautifully on the right spot on the curve. We think we will soon have something for pottery as accurate as the Carbon-14 method.

These are just examples of several things we are doing in the techniques field, and Iaam convinced that archaeology, like almost everything else, is going to be drastically affected by current technological explosion.

Pen and I are just back from the Near East, and I plan to stick around here for the next couple of months.

My very best to you and Marian,

As ever,

Froelich Rainey
Director

Mr. Francis Boyer
Chairman, Board of Trustees
Smith, Kline & French, Inc.
15th and Spring Garden Streets
Philadelphia, Pennsylvania

FGR/vg

BOYER

Techniques

January 20, 1966

Dear Mook:

You will remember that you gave us $1,000, this past year, to assist in the development of the cesium magnetometer, and this is my report on the great success of that experiment with the new instrument.

Beth Ralph, our physicist, has now returned from Italy with all the data on the survey made there this fall, and it is very impressive because with the cesium magnetometer she was able to spot specific buildings lying about 20 ft. deep, and to chart the location of all buildings on the eastern side of the site. This has been the most successful development of an instrument we have had during the past five years. But, of course, we have the experience with the rubidium magnetometer which went into the design of the cesium instrument. You will be interested to learn that the Harvard Observatory now wants to try it out in their search for meteorites and the Defense Department wants to try it for the location of cavities underground. We have the only instrument in existence and I am delighted to see these requests for its use because it may mean that Varian Associates will then put it into production which will allow archaeologists to buy it at a reasonable price. We have some problems with the batteries which will have to be improved, and we will continue the survey at Sybaris in the spring for further tests with the instrument and to see if we can make further improvements.

In any case, I want you to know that this was one scheme of ours that really worked out and I am very grateful for your contribution which made it possible. I haddto raise $25,000 in a hurry to pay one half the cost of the new design and construction of the experimental instrument. We got the money just in time and the instrument was delivered almost on schedule.

Henry Watts tells me that you expected to accompany us to Tikal and to the Passion River for our fishing expedition, but then decided you could not get away. I am very sorry about this because I am sure you would very much enjoy the jungle fishing and also to see the site now that the very large palace area has opened up. Moreover, this is just for fun since we do not need any more money for Tikal, the bill now being paid by the Guatemalan Government.

If you can overcome your conscience, you can still join us on the 4th of February for a week's trip.

Very best wishes,

Froelich Rainey
Director

Mr. Francis Boyer
Smith, Kline and French
15th and Spring Garden Street
Philadelphia, Pennsylvania

FGR/vg

THE ARCHAEOLOGICAL EXPEDITION TO TELL ARAD

THE UNIVERSITY OF NORTH CAROLINA
AT CHAPEL HILL
CHAPEL HILL, N.C., U.S.A.

THE HEBREW UNIVERSITY
AT JERUSALEM
JERUSALEM, ISRAEL

9 January, 1968

Miss Elizabeth Ralph
The University Museum
University of Pennsylvania
Philadelphia, Pennsylvania

Dear Miss Ralph:

In a recent conversation with Professor James Pritchard, I asked his advice concerning having a Carbon 14 test made on a specimen of charred wood which we excavated in a pre-Solomonic stratum at Tell Arad this past summer.

Soon after I returned to the States in the fall I wrote the Radio-Carbon Lab in Washington. After several weeks, they notified me to contact the Smithsoniah, which I did at once, but without ay acknowledgement. Consequently, the months are rushing by, and I am most anxious to have the specimen dated by Carbon 14.

Professor Pritchard indicated that you might be able to work this request into your schedule. I would be most grateful if you could arrange to have the charred wood tested for me. Please do what you can for me.

Sincerely,

Bernard Boyd

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