[Undated]

Dear Miss Ralph:

Here is what I thought might prove useful for the history of metallurgy:

A young cuneiform scholar to devote several years to the study of metals and metal technology in the Ancient Near East, as evidenced in the cuneiform documents, and particularly in the Sumerian literary works now being pieced together and translated primarily at the University Museum, from some 5000 tablets and fragments scattered throughout the museums the world over. The yearly stipend for this young cuneiformist, I would suggest to be $4500.

SNK

November 1, 1961

Mrs. Althea Revere
7 Gates Farm
Vineyard Haven
Martha's Vineyard, Mass.

Dear Mrs. Revere:

It was good news to hear that you are interested in the old vs. new gold problem. A purchase order from the University Museum is on its way, that is, after it succeeds in escaping from the various University offices.

I have enclosed two copies of Expedition in which two gold objects from Iran are shown. Some objects will be sent separately within a week or so. The ancient bowls and so forth from Iran were made by melting gold into discs, then pounding them into shape.

That makes me wonder about the effect of this cold working on the crystal and/or grain structure and so forth. At your convenience, could you let me know more details about the structural changes that you expect to find? I'd like to have a vague idea of the problem before I talk to metallurgists here who might be interested, or who might be able to advise us if we need their help. As you can see, I know practically nothing about metallurgy, but have a few books which will help with the terminology.

With best wishes for the success of your studies, I am,

Sincerely yours,

Elizabeth K. Ralph

EKR/bg
Enc.

March 2, 1962

Mrs. Althea Revere
7 Gates Farm
Vineyard Haven
Martha's Vineyard, Mass.

Dear Mrs. Revere:

Dr. Rainey and I want to thank you for coming here and showing us your encouraging results of photographs of the preliminary gold studies.

Under separate cover we are sending 12 additional gold samples and the clay sickle. Some of the gold pieces are thin, hammered ones, similar to those in the first lot. Please feel free to break off small pieces in order to study freshly-exposed surfaces. Other pieces appear to be cast. No. SA2777, an alligator or dog, was included primarily because one side was polished and the other, unfinished. A study of the two sides may be interesting.

In regard to the clay sickle, the main question is whether or not it was used for cutting grain, etc. This one has not been used since excavation for experimentation with cutting. Therefore, if you find any bits imbedded in it, they may be assumed to be from its use in ancient times.

The University Museum is sending also a purchase order for $1000.

With best regards,

Elizabeth K. Ralph

January 9, 1962.

Mrs. Althea Revere,
7 Gates Farm,
Vineyard Haven,
Martha's Vineyard, Mass.

Dear Mrs. Revere:

The good results which you reported on Friday sound very encouraging. In regard to your possible visit, I am in somewhat of a quandary. Mr.Dyson, who submitted the gold samples and knows the most about them, leaves for Tikal, Guatemala on Friday, January 12th for six months. Also, his assistant will be away until February 20th. Dr. Rainey will be in Italy until January 17th and will probably be available on the 18th or 19th, but may be late in returning. We shall all be tied up on January 20th because of a convocation in celebration of the 75th Anniversary of the Founding of the University Museum.

Therefore, if you are able to come here, I think that the 19th would be best. If, however, under these circumstances, you prefer to send a brief written report or to meet me in New York, any arrangement you make will be fine with me. The one exception is January 20th when I have to be here.

With best regards,

Elizabeth K. Ralph
EVergreen 6-0100 Ext. 8168
or EVergreen 6-1241

EKR:LF

August 22, 1962

Dr. A. P. Hornblower
Research Laboratory for Archaeology &
the History of Art
6 Kelsle Road
Oxford, England

Dear Dr. Hornblower:

I continue to think of the enjoyable time I had talking to you in Oxford and wish to thank you for your kind hospitality in your laboratory.

I now seem to be back at work although it is somewhat hard to believe. Dr. Cyril Smith from Massachusetts Institute of Technology is coming here on the 31st of August for a very brief visit, but unfortunately, our chairman of Metallurgy, Dr. Robert Maddin, is going to Japan until the end of September. Therefore, the meeting about which I talked to you will be postponed until later this fall if it comes about at all. I just realized, however, that I probably should have those useless electron microscope photographs here for Dr. Smith's visit, and wonder if you would mind sending them by air mail. I should have brought them with me, but I am afraid that I forgot them.

We appreciate very much your kind offer of assistance and collaboration with this problem of determining the antiquity of gold objects. Shall I send you a few samples of ancient gold in the near future, or shall I wait to hear from you when you are ready to study them? In the meantime, I'll try to obtain information about their manufacture and surroundings when Mr. Dyson returns from Iran.

Sincerely yours,

Beth Ralph

EKR/deh

STUDIES FOR THE DETERMINATION OF THE ANTIQUITY OF GOLD OBLECTS

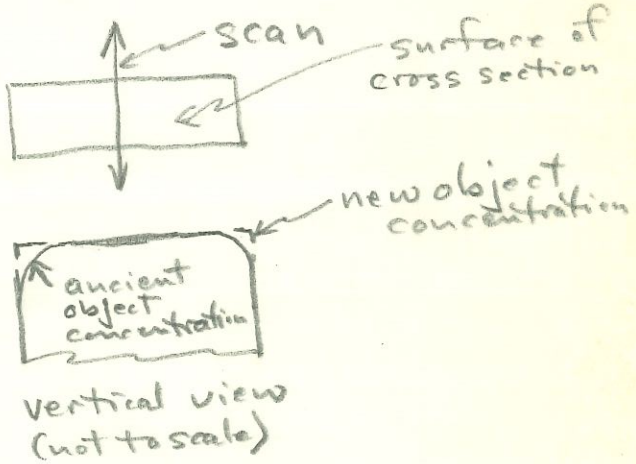
1) Mrs. Althea Revere, microscopy specialist from Martha's Vineyard, Mass.

We submitted samples to Mrs Revere from Hasanlu, Ur, Etruria, etc. She has made electron microscope photographs of surface replicas. She has taken several replicas from the same spots to reduce surface dirt; no other cleaning. She believes that she sees a change in the surface of ancient gold objects -- namely, the appearance of octahedral crystals. It is felt by Dr. Maddin and others that this would be an unlikely occurrence, but that the possibility exists of "seeing" some change due to the presence of impurities.

2) Dr. A.P. Hornblower ~~has offered to study~~, Research Laboratory for Archaeology and the History of Art, Oxford, England

Dr. Hornblower has offered to study cross sections (freshly cut) of gold objects with the electron probe microanalyser which will soon be in operation in the Oxford laboratory. By scanning across a surface, it may be possible to detect an enrichment or depletion of the gold content near the edges of an object. (See sketch). This may be due to slow oxidation, diffusion, dilution effects, or some such cause. (Reference: E.T. Hall, "Surface-Enrichment of Buried Metals," Archaeometry, vol. 4, 1961, p. 62-6.

Because of the need of a freshly cut cross section, this technique is destructive. Minimum sample size required is approximately 1 x 2 x 3 mm.



ASOA PROJECTS
Aug. 30, 1962

November 21, 1962

COPY

Dr. P. Hornblower
Research Laboratory for Archaeology and
the History of Art
6 Keble Road
Oxford, England

Dear Penny:

Many thanks for your letter of two months ago. It seems to have taken this much time for me to collect the gold objects and obtain permission for sampling them from the curators. They are being sent separately by airmail and the information sheets about them are enclosed.

These objects have all been viewed in the electron microscope by Mrs. Revere, and her suspicions of impure metals, etc. are noted on the sheets. On some of them we have also taken "spark" samples with an emission spectrograph to see what we can find out about the impurities. You can see the slightly damaged surface where we did this. If these tests afford any useful information, I'll forward the results to you as soon as available.

I have told the curators that you would need to cut off pieces not larger than 1 x 2 x 3 mm, and it would be appreciated if you damage them as little as possible. The gold coin (no. 29-126-1076) is the most valuable. Please sample it at the edge (outside of the figures) in such a way that the cut can be polished and obscured when returned.

I haven't been able to locate any fakes except for one on exhibit which they won't part with, but I'll continue to look. Many were exhibited in Paris, but they now have high prices on their heads.

Please return all the objects when you have finished with them.

Best of luck with your experiments, and many thanks for your kind cooperation.

Sincerely yours,

Elizabeth K. Ralph

encl;

EKR:dml

Gold objects to be sent to Oxford 1/9/63

29-126-1076 Roman coin from Gordion ~~($40.00)~~ $1,000.
SA 2777 Costa Rica animal 1 1/4" long $250.
CBS 16787 Ur gold ribbon $25.
CBS 17000 Ur diadem fragments $25.
40-13-34 Cocle gold bangle (46 in lot) - just 1 - $5.00
~~Just~~ 40-13-~~323~~ 223 Cocle gold nose ornament — $75.
40-13-14 Cocle disc 5.5 x 5.5 cm. $35.
SA 2709 gold disc - Antioquia - (13 in lot) - just 1 fragment - $20.00
30 -33-24 Scythian gold button (3 in lot) $50.

Total $1485.

E. Ralph

Beth -
This is going by registered first class air mail today. Our insurance people are covering at full value of $1485.
(the $2577. was wrong addition).

Geraldine

1/9/63

REPORT ON GOLD OBJECTS BY SPECTROGRAPHIC ANALYSIS.

OBJECT: To determine the elements that are present in the Gold Objects.

SPECIMEN: Following samples were examined with Electron Microscope by Mrs. Althea Revere of 7 Gates Farm, Vineyard Haven, Martha's Vineyard, Mass.

Samples were grouped by their locations.

GROUP	CATALOG NO.	LOCATION
I	30-33-21	South Russia, Kuban Region, Maikop.
	30-33-24	" " " " "
II	CBS-16787	Ur, Royal Cemetery
	29-126-1076	Rome, Italy (240 A.D.)
III	40-13-323	Panama, Sitio Conte
	40-13-34	" " "
	40-13-14	" " "
	SA-2777	Costa Rica
	SA-2709	Colombia, Near Ayapel

RESULTS: Samples were excited by DC arc method with a graphite as upper electrode. The resulting spectral lines were identified and compared visually.

Au, Ag, Cu, Mg, and Fe were found. Relative amount of each element present in a sample is indicated by the following order: +++ ++ + P (Present), ∱ (Trace), - (Absent) as shown in the table.

GROUP	CATALOG NO.	ELEMENTS PRESENT (RELATIVE AMOUNT)				
		Au	Ag	Cu	Mg	Fe
I	30-33-21	++	+++	+	P	∱
	30-33-24	+++	+++	++	+	∱
II	CBS-16787	+++	+++	++	+	P
	29-126-1076	++	+	P	P	∱
III	40-13-323	+++	+++	++	+	P
	40-13-34	+	+	++	-	∱
	40-13-14	+++	++	+	+	P
	SA-2777	++	++	++	P	∱
	SA-2709	+++	++	++	+	∱

M. Han
1/63

MASSACHUSETTS INSTITUTE OF TECHNOLOGY CAMBRIDGE 39, MASSACHUSETTS
Room 14N-321

26 March 1963

Mr. Reed Knox, Jr.
Department of Metallurgy
University of Pennsylvania
33rd and Walnut Streets
Philadelphia 4, Pennsylvania

Dear Mr. Knox:

Thanks for your letter of March 14. I knew of your association with the Applied Science Center--indeed, Professor Maddin had suggested that I try to invoke your aid in doing some metallography on some ancient iron and steel samples that I have. I intend to do this very soon, but I've not had an opportunity to collect the informatinn as well as the samples.

I really don't have the slightest idea how you can prepare gold oxide. I would assume that the standard textbooks of inorganic chemistry tell you something about it. (Precipitating a gold solution [?bromide?] with NaOH?) Au_2O is quite unstable with heat and is not, I think, of any metallurgical significance whatever. My interest in dilute alloys of gold in copper comes from quite different directions--(a) the production of a yellow gold-rich surface on a dilute alloy by preferential oxidation of the copper and pickling away the oxide and (b) the production of a highly colored patina on such alloys by appropriate pickling, as was done especially by the Japanese Tsuba makers. You will find the first described in a paper or two by Paul Rivet on Peruvian metallurgy, summarized in his book with Arsandaux, La Metallurgie en Amerique pre-columbienne (Paris 1946), and in a paper by W. C. Root in the Handbook of South American Anthropology (approximate title)*. The Japanese process is best described by Roberts-Austen in the Journal of the Society of Arts (London) 1888, 36, 1137-46 and 1893, 41, 1022-43. It is really an admirable technique--no other finish on metal is comparable with it. It apparently depends on the formation of a copper oxide or hydroxide layer in which colloidal gold particles are dispersed. But you want gold oxide and none of this is any use. Sorry!

Yours sincerely,

Cyril Stanley Smith
Institute Professor

CSS:mk

*also see Root in Lothrop (Ed) Essays on Pre-columbian Archaeology (H.U.P)

RESEARCH LABORATORY FOR ARCHAEOLOGY
AND THE HISTORY OF ART

TEL. 55211

6 KEBLE ROAD
OXFORD

APH/JH

31st July, 1963.

Dr. E. Ralph,
Department of Physics,
Physical Sciences Building,
University of Pennsylvania,
Philadelphia 4,
Pennsylvania, U.S.A.

Dear Beth,

This is just a short letter to tell you that I am making some small progress with the specimens you so kindly sent me. I have obtained one or two qualitative results and it seems that there is a good chance that some sort of semiquantitative system of classifying the gold will be forthcoming.

There are, of course, many difficulties to be overcome - notably a way of standardising the preparations of the speciments, ludicrous though that seems. A Dr. Ziebold of M.I.T. has been working on pure Cu-Ag-Au systems, and has very kindly furnished me with what are effectively standardisation curves, so that my calculations are greatly simplified.

As soon as I have more definite results I will send them to you - I think they will interest you.

Thank you again for your help.

Yours sincerely,

Penny Hornblower

Penny Hornblower.

P.S. The figures you sent me for the analyses of the specimens don't agree with any figures I have been able to obtain; I have used my instruments, optical spectroscopy and fluorescence analysis, and in each case the amount of copper and silver is much less than I deduce from your "crosses" system. I wonder if you have any idea how accurate your analyses are?

A.P.H.

for R. Dyson
11/14/63

Photo #5 of part no. 60-20-107

Gold - from Hasanlu, Solduz Valley, Azerbaijan, Iran.
From 9th century B.C. level of Burned Building I
[1959 dating].
University Museum Cat. No. 60-20-107.

Photograph taken with electron microscope by Mrs. Althea Revere, Vineyard Haven, Martha's Vineyard, Mass. at magnification of x 20,000.

Purpose of this study was to find a means of differentiating between ancient gold objects and modern fakes. In this photograph, forms of various shapes (of the same light color as the background) may be seen. Mrs. Revere believes that these are predominantly octahedral and may be an indication of the antiquity of the object since they were not seen in the one modern object studied. Metallurgists find it difficult to accept this thought, but have suggested that it might be possible to see some change in the regions of impurities.

Similar ancient gold objects are now being studied by Dr. P. Hornblower at the Research Laboratory for Archaeology and the History of Art, Oxford University, with an electron probe analyzer. This is a specialized instrument designed by Dr. E. T. Hall. By scanning cross-sections of the gold objects, it is hoped that it may be possible to detect some evidence of diffusion at the outer surfaces. This might appear as an enrichment of the gold content near the surface due to the diffusion and consequent depletion of less stable impurities.

THE BROOKLYN MUSEUM

EASTERN PARKWAY, BROOKLYN 38, NEW YORK

Ralph
As ck

January 25, 1965

Dr. Froelich Rainey, Director
The University Museum
University of Pennsylvania
33rd and Spruce Streets
Philadelphia 4, Pennsylvania

Dear Fro:

The Brooklyn Museum and New York University are planning to collaborate on a technical study of ancient gold technology, concentrated primarily on the invention of refining and alloying of gold. Dr. S. Z. Lewin, Professor of Chemistry and Professor of Fine Arts at NYU, and Patricia F. Davidson, Research Associate in my Department and a trained goldsmith, will be the principal scientists. They expect that an exhaustive study of carefully selected objects under controlled conditions will shed light on gold-working techniques of the entire ancient world, such as casting, soldering and gilding. It should be equally revealing to related technologies and crafts, industries and economic studies of the ancient world.

The material to be tested in the NYU laboratories will undergo examination by microscope, X-ray, fluorescence, and chemistry. The chemical analysis alone requires that a milligram (a fleck about the size of a pinhead) will have to be removed and destroyed. The microscopic and X-ray tests are entirely harmless to the objects. This means of course that only a few objects can be selected for the chemical analysis, but many more for the other examinations.

I am mainly writing to you today to find out if in principle you, as one of the great excavator institutions in this country, would be willing to cooperate? We are planning a major appeal for funds to the National Science Foundation and naturally would like to name those institutions which, in principle, might be willing to cooperate with us in this long range venture.

With best regards and all good wishes,

Sincerely yours,

Bernard

Bernard V. Bothmer
Curator of Ancient Art

BVB/ss

rec'd reply
from Patricia F. Davidson

January 27, 1965

Dr. Bernard V. Bothmer
Curator of Ancient Art
The Brooklyn Museum
Eastern Parkway
Brooklyn 38, N. Y.

Dear Dr. Bothmer:

Fro Rainey has asked me to reply to your letter of January 25th.

We shall be very glad to cooperate with you in your program of technical studies of ancient gold technology. Needless to say, we are pleased to learn that you are initiating this much needed project.

At the request of Robert Dyson (Associate Curator of Near Eastern Archaeology), we have been trying to find a means of differentiating between ancient gold objects from Persia and modern fakes. Since the fakes are frequently made from melted down ancient objects, we decided that trace analysis would not be of much use. Therefore, Mrs. Althea Revere carried out some surface studies with her electron microscope. We feel that these were inconclusive, but would be glad to show (or lend) you her photographs if they would be of any use.

Our next step was to send some ancient objects (mostly the same ones) to the Research Laboratory for Archaeology and the History of Art, Oxford, England for examination with their electron probe microanalyser. Our hope is that it might be possible to detect some evidence of diffusion near the surfaces, that is, either depletion or enrichment in gold content, which would be an indication of age or lack of it. Approximately two years have elapsed during which their analyser has been broken down or "not ready", but I shall write to Martin Aitken immediately to inquire about the present state of progress. If something comes of this, it might be worthwhile to examine these same objects by your suggested techniques. In the group are

Dr. Bernard V. Bothmer January 27, 1965

Scythian, 4th-3rd B.C. objects, ones from the Royal Cemetary at Ur, a Roman coin, an alligator from Costa Rica, and ornaments from Panama.

Please let us know how we may assist specifically with your program.

Sincerely yours,

Elizabeth K. Ralph

EKR/deh

Structure ?

Effect of cleaning, etching
Eric Usual composition of Ag alloys

Ch. V, pp. 205 ff.

Pure Metals

Solid Solu. of 2 metals

Substitution - 2nd element replaces atoms of the 1st at random in its lattice structure, w. certain distortion.

Interstitial - if small enough, 2nd ele. atoms may occupy empty spaces in the somewhat open structure of the lattice.

Melt into disc, then pound

Not cast

Unit cube for Cu = 3.608 Å (10^{-8} cm)
" " Ni = 3.517 Å

Complete solid solubility Cu - Ag - soluble in all proportions

Ordinary metal composed of a great no. of
→ p. 124 small crystalline units, variously arranged, called grains. Cold working may decrease the grain size & increase tensile strength.

Table 22 p. 128

Gold	Tensile Str. psi	
	20,000	Cast
	37,000	Hard-drawn wire

Larger crystals - slow cooling
Pouring temp. affects crystal size
Cold working makes crystals assume form of elongated platelets,

Sent to Mrs A. Revere 11/8/61 Returned 2/16/62
7 Gates Farm
Vineyard Haven
Martha's Vineyard, Mass.

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E. K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1.	Descriptive name or site, and brief explanation of significance of sample or site.	Gold bulla-type pendant from necklace. MS. 3362 Hammered ~~in two pieces~~ and joined around edge. Etruscan
2.	Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.	Gold.
3.	Precise geographic location including latitude-longitude coordinates.	Etruria, = west-central Italy.
4.	Occurrence and stratigraphic position in precise terms.	Unstratified.
5.	Date of collection and name of collector.	?
6.	Name of person submitting the sample to the laboratory.	E. Kohler November 7, 1961
7.	Any further necessary explanation.	Exact provenience unknown because it was a gift of John Wanamaker to Univ. Museum.
8.	Reference to relevant publications.	
9.	Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.	4th or 3rd century B.C. assigned by style of palmette on back.

Sent to Mrs. Revere 11/8/61
1 chip kept 2/16/62

SAMPLE INFORMATION REQUIRED FOR ~~C14 DATES~~ ANALYSIS

Send to: E. K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — Hasanlu, Solduz Valley, Azerbaijan, Iran

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold - blob

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms. — From the ninth century BC (~~XXXX~~) levelx of Burned Building I

5. Date of collection and name of collector. — 1959, R. H. Dyson, Jr.

6. Name of person submitting the sample to the laboratory. — R. H. Dyson, Jr.

7. Any further necessary explanation. — University Museum # 60-20-107

8. Reference to relevant publications. — Expedition I (3), 1959, Philadelphia, University Museum. This has been sent to you.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Sent to Mrs. Revere 11/8/61

Sample Information Required for IBM Card File of
University of Pennsylvania C-14 Dates

1. Descriptive name or site, and brief explanation of significance of sample or site.

Necklace = Chain
19th century America ? ✓

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.

Gold; we hope it is not plated

3. Precise geographic location including latitude-longitude coordinates.

?

4. Occurrence and stratigraphic position in precise terms.

?

5. Date of collection and name of collector.

6. Name of person submitting the sample to the laboratory.

Miss Elizabeth Ralph
November 8, 1961

7. Any further necessary explanation.

we think it is about 100 years old; we know it is older than 50 years.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Selected since it does not appear to be a cast piece so may be similar in manufacture to the ancient pieces.

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site.	South Russian, Kuban Region, Maikop Scythian, IV-III century B.C.
2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.	Gold, tiny round button(D. .8cm.) with loop
3. Precise geographic location including latitude-longitude coordinates.	
4. Occurrence and stratigraphic position in precise terms.	
5. Date of collection and name of collector	30-33-24 Gift Purchased from Canessa Auction
6. Name of person submitting the sample to the laboratory.	RHDyson, Jr. E. KOHLER
7. Any further necessary explanation.	
8. Reference to relevant publications.	
9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.	

Valuation: $50.00
Returned from Mrs. Revere Oct 1962
B Clifford

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — Panama, Sitio Conte, Coclé, Tr, 2m B 11

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector — 40-13-14 Gold disc; six small bosses around large central boss.

6. Name of person submitting the sample to the laboratory. — WHDyson, Jr.

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Valuation $35.00

Returned by Mrs. Reeves Oct 1962
Sent to Clafford

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. **Colombia, Antioquia, near Ayapel**

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. **Gold; fragment of decorated disc edges crimped**

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector **SA 2709 Gold disc fragment Purchased 1920**

6. Name of person submitting the sample to the laboratory. **RHDyson, Jr. From American Section**

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

valuation $20.00

Returned by Mrs. Pevere Oct 1962
Sent to Oxford U. England

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — Costa Rica

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector — SA 2777 Gold animal, alligator or dog, Head up; loop under feet for suspension. [RHDyson, Jr. From American Section]

6. Name of person submitting the sample to the laboratory.

7. Any further necessary explanation. — This specimen selected for the polished worked outer surface and the rough inner unfinished surface.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted. — Purchased in 1920

Valuation $250.00

Returned by Mrs. Rowe Oct. 1962
Sent to Clifford

Sent to Mr. Nielson 4/25/70

HASANLU PROJECT - SPECIMEN DATA SHEET

Sample No. HAS 62-844 **Lab. Sample No.**_____

FIELD DATA:

1. **Site or descriptive name:** Hasanlu Tepe, Solduz Valley, W. Azerbaijan, Iran
2. **Geographic location:** **Longitude:** 45°25"E **Latitude:** 37°N
3. **Period or phase:** period IV
4. **Approximate date:** ca. 1000-800 B.C.
5. **Provenience: stratigraphic or otherwise:** Q 24 (3)/3//19
6. **Collector and date of collection:** R.H. Dyson, Jr. 1962
7. **Description of sample:** Cu/Br? solid rectangular object with 4 feet, sawed in half

Want to know what they are made of & how they were made.

8. **Photograph negative number:**

LABORATORY DATA:

9. **Laboratory to which submitted:** MASCA, University Museum, Phila. 19104 University of Pennsylvania
10. **Person to whom submitted:** Elizabeth Ralph
11. **Date submitted:** April 22, 1970
12. **Person submitting to laboratory:** R. H. Dyson
13. **Results of analysis:**

14. **Comments on results: Significance, comparison to other samples, etc.**

DISPOSITION:

15. **Disposition of specimen:**
16. **Disposition of technical report:**
17. **Publications:**

PRESERVATION COPY
2/5/2015

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site.	Panama, Sitio Conte, Cocle, Pr. 2m B 11
2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.	Gold
3. Precise geographic location including latitude-longitude coordinates.	
4. Occurrence and stratigraphic position in precise terms.	
5. Date of collection and name of collector	40-13-14 Gold disc; six small bosses around large central boss.
6. Name of person submitting the sample to the laboratory.	~~[illegible], Jr.~~ L. Satterthwaite
7. Any further necessary explanation.	
8. Reference to relevant publications.	
9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.	

Oxford 11/21/62

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — Panama, Sitio Conte, Cocle, Tr. 2, B 11, skeleton I

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold, triangular; cut edges

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector — 40-13-34 Gold bangle; 2 drill holes Excavated 1940

6. Name of person submitting the sample to the laboratory. — RHDyson, Jr. L. SAMPEL + NEW ARTS

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Valuation $5.00

Returned by Mrs. Reece Oct 1962
Sent to Oxford

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. Panama, Sitio Conte, Cocle, near grave 17

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. Gold

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector 40-13-223 Nose ornament
Excavated by Museum, 1940

6. Name of person submitting the sample to the laboratory. RHDyson, Jr. From American Section

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Valuation $75.00

Returned by Mus. Revenue Oct. 1962
Sent to Oxford

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SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. Panama, Sitio Conte, Coole, near grave 17

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. Gold

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector 40-13-323 Nose ornament
Excavated by Museum, 1940

6. Name of person submitting the sample to the laboratory. ~~R.F. Heizer, Jr.~~ Fron American Section
L Satterthwaite

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Oxford 11/21/62

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — [Rome] ~~Rome~~, Italy (240 A.D.) The mint

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold coin 5.09gms

Dorothy Hannah Cox

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms. — Not known

5. Date of collection and name of collector — 29-126-1076 (Brock Coll.)

6. Name of person submitting the sample to the laboratory. — ~~RHDyson, JH~~, EK.Ralph
E. Kohler

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

$ 1,000

Returned by Mrs. Nevea
Sent to Oxford k.
[For small-sample hon
mag in]

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2/5/2015

~ 3/2/62

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site.

   Eridu, Iraq, south of Ur. Clay sickles of this type are found in many sites of this period(4000-3000 B.C.). Discussion has ranged around various possible uses One thesis involves substitution for copper.
   Pottery sickle, one half present.

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

   Sumerian 4000-3500 B.C.

5. Date of collection and name of collector

   61-19-6 Gift

6. Name of person submitting the sample to the laboratory.

   RHDyson, Jr.

7. Any further necessary explanation.

   Submitted to determine of specimen has ever been used to cut with.

8. Reference to relevant publications.

   cf. Childe, V.Gordon., New Light on the Most Ancient East and Lloyd, Seton and Safar, Fuad Eridu in Sumer IV (2) Sept. 1948

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

   The question at issue is whether or not such pottery sickles were ever in any way actually used for cutting anything. Sickle blades are said to develope a gloss from the silicon in the grain stems, is any abrasive action to be seen on sand grains in the surface clay for example?

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — Ur, Royal Cemetery,[?]

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector — CBS 16787 Fragment of gold ribbon
Expedition VII, catalogued March 19 1929

6. Name of person submitting the sample to the laboratory. — RHDyson, Jr.

7. Any further necessary explanation. — Probably earlier excavation season than other specimens

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

$25.00

Returned by Mrs. Devere Oct. 1962
J T Oxford

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site.

   Ur, Royal Cemetery, PG 777

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.

   Gold leaf(U 9787) once attached to short copper rods 60mmm long once encased in very thin gold.

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector

   CBS 17000 Diadem fragments
   Catalogued March 1929; RHD 1934
   Expedition VI season; probably excavated seasons prior to '29.

6. Name of person submitting the sample to the laboratory.

7. Any further necessary explanation.

   $ 25.00

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Returned from Mrs. Revere. Oct. 1962
Sent to Oxford U. England

Sent to Mrs. A. Revere 11/8/61

SAMPLE INFORMATION REQUIRED FOR C-14 ANALYSIS DATES

Send to: E. K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — Ur, Iraq

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold

3. Precise geographic location including latitude-longitude coordinates. — Lat 30.56N, Long 46.08E

4. Occurrence and stratigraphic position in precise terms. — From a grave dating to about 2500 BC

5. Date of collection and name of collector. — Sir C. Leonard Wooley, ca 1930

6. Name of person submitting the sample to the laboratory. — R. H. Dyson, Jr.

7. Any further necessary explanation. — Leaf University Museum # 17574
Triangle " " # in box with 30-12-742

8. Reference to relevant publications. — Woolley, C.L. The Royal Cemetary, 2 vols, 1934, Oxford, University Press

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

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SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. — Ur. Royal Cemetery

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. — Gold wire, coiled; Called two rings on catalogue card; changed to hair rings?

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector — 30-12-705A. Excavated 1928-9 season C.L.Woolley

6. Name of person submitting the sample to the laboratory. — R.H.Dyson, Jr.

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

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SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site.

   Ur, Royal Cemetery. PG 777

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.

   Gold leaf(U 9787) once attached to short copper rods 60mm long once encased in very thin gold.

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector

   CBS 17000 Diadem fragments
   Catalogued March 1929; MMD 1938
   Expedition VI season; probably excavated seasons prior to '29.

6. Name of person submitting the sample to the laboratory.

   R. Dyson Jr.

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

Oxford 11/21/62

SAMPLE INFORMATION REQUIRED FOR C-14 DATES

Send to: E.K. Ralph, Department of Physics
University of Pennsylvania
Philadelphia 4, Pennsylvania

1. Descriptive name or site, and brief explanation of significance of sample or site. Ur. Royal Cemetery. PG 1133

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen. Gold; annular with lunate ends

3. Precise geographic location including latitude-longitude coordinates.

4. Occurrence and stratigraphic position in precise terms.

5. Date of collection and name of collector 30-12-758 b Excavated 1928-29 season

6. Name of person submitting the sample to the laboratory. RHDyson, Jr.

7. Any further necessary explanation.

8. Reference to relevant publications.

9. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted.

October 4, 1966

A meeting of the Metallurgical Project is scheduled for Friday, October 14th at 2:00 P.M. in the Director's Office, University Museum.

E. K. Ralph

CC:

University Museum

Dr. George Bass

Dr. George Dales

Mr. Robert Dyson

Mr. Michael Katzev

N.G.

Miss Judy Kingston

Miss Carol Kramer

Dr. Samuel Kramer

Miss Ruth Matson

Mr. David O'Connor

Dr. James Pritchard

Dr. Froelich Rainey

Miss Beth Ralph

Mr. James Weinstein

Miss Gayle Wever

Department of Metallurgy

Dr. Robert Maddin

Mr. Alfred Spitalieri

March 7, 1968

A meeting of the Metallurgical Archaeological Project is scheduled for Wednesday, March 13th, at 11:00 A.M. in the Director's Office, University Museum.

Elizabeth K. Ralph

CC: University Museum

Dr. George Bass

Mrs. Judith Bjorkman

Dr. George Dales

Dr. Nicholas David

Dr. William Davenport

Dr. Robert Dyson

Mr. Michael Katzev

Dr. Alfred Kidder, II

Mr. Jeffrey Kline

Dr. Samuel Kramer

Miss Ruth Matson

Mr. David O'Connor

Dr. James Pritchard

Dr. Froelich Rainey

Miss Beth Ralph

Dr. Bernard Wailes

Dr. James Weinstein

Miss Gayle Wever

Mr. John Witthoft

Dr. Rodney Young

Department of Metallurgy

Mr. Robert Maddin

Mr. Alfred Spitalieri

Mr. Dan Tomalin

UNIVERSITY of PENNSYLVANIA

PHILADELPHIA 19174

(215) 594-[redacted] 5241

ROBERT MADDIN
University Professor of Metallurgy

December 13, 1973

Dear Colleague,

We are organizing a discussion group concerned with the history of metallurgy and with the role that metals have played in ancient cultures. We have in mind meeting on the order of once a month at which time one of the group will report on studies and research he or she is doing in these areas. Although the first meeting will be organizational, I (RM), along with James D. Muhly of the Ancient History Department, will talk about the results of analyses of the Cape Gelidonya Ox-hide Ingot. The first meeting is scheduled for:

Friday, January 18, 1974 - 8:p.m.
LRSM Building - Rooms 106/107
33rd and Walnut Streets
University of Pennsylvania

We are not acquainted with all persons who may be interested in joining this group; hence, if some of your colleagues have not received this notice, by all means invite them. We hope that there will be a good turn-out for this initial meeting.

Robert Maddin

Gary W. Carriveau
MASCA