

MEMORANDUM

To: Mr. Samuel B. Eckert
Sun Oil Company
1600 Walnut Street
Philadelphia 3, Pennsylvania

From: Froelich Rainey

Date: November 30, 1960.

Here are the two items we discussed on the phone:

1. Johnson and Linnington discussed our project for developing an underground explorer for archaeology with McDermott, Agnich, Dunlap and Romberg. McDermott informally told his men to go ahead with the project, but they have never actually set it up. Johnson called both Romberg and Agnich last week and they both said that they still had not gotten any instructions from Mr. McDermott to go ahead, although both were very much in favor of the idea. As you know, I wrote Mr. McDermott about two weeks ago and have received no reply. This whole thing seems very strange, because everyone has said that everything was all set and yet there have been no official instructions from Mr. McDermott.

For your information, Mr. McDermott is Chairman of the Board of Texas Instruments. Fred Agnich is one of the Board of Directors and head of the Instruments Division, Fred Romberg is Chief Geo-Scientist and Robert Dunlap is President of the Subsidiary Company to Texas Instruments, which makes the instruments. So you see, all the top men in the company have approved this job in principle. I hope you can get Mr. Pew to call Mr. McDermott when he is Texas and smoke this thing out.

2. Rodney Young wants one of those earth-moving tractors which has an earth-moving bucket attached to the front end. He believes that several manufacturing companies like Allis-Chalmers, International,

*Archaeological
Techniques
C.V. Eckert*

Mr. Samuel B. Eckert

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November 30, 1960

Caterpillar Tractor, etc., have agencies in Ankara and that one of these companies should be able to arrange the loan of a tractor to him for the work at Gordion during the summer months of May, June and July. We could give them very good publicity in exchange for the use of a machine in archaeology at the site. If I can get the name of some man in charge of one of these companies, I will write to him urging the loan to us for the coming summer. I think it would be quite useless to write to any one of these companies unless it is directed to someone in a very responsible position.

If there is any question about either of these things, please ring me up.

S. B. ECKERT
1600 WALNUT STREET
PHILADELPHIA 3

WJ

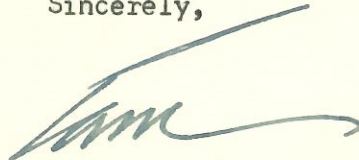
December 5, 1960

Dear Fro:

Following up your memorandum of November 30,
I am enclosing copy of letter I have written to Jack
Pew regarding Texas Instruments, and I shall let you
know as soon as I have a reply.

I am looking into the matter of an earth-moving
tractor for Rodney Young's use in Gordion and shall let
you know as soon as I have any information.

Sincerely,



SBE:r
encl.

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

C O P Y

FOP

INTER-OFFICE CORRESPONDENCE SHEET
SUN OIL COMPANY

SUBJECT:

DATE: December 5, 1960

FROM:

S. B. Eckert,
2nd Floor - 1600 Building

OFFICE: Philadelphia

To:

Mr. Jno. G. Pew, Vice-President
19th Floor - 1608 Building

Dear Jack:

Attached hereto is copy of a portion of Dr. Rainey's memorandum to me concerning The University Museum's problem with Texas Instruments.

I understand that you know Mr. McDermott quite well and I am wondering if it would be asking too much for you to give him a call the next time you are in Dallas, and ask him whether there is any hold-up in this development, or whether he simply has been so busy he has neglected to talk to his associates.

As far as financing is concerned, we have tried to get them to go along on a 50-50 basis with us, the Museum paying one-half and Texas Instruments making a donation of the other half.

Mr. McDermott seemed quite interested in the Museum's work, particularly in Tikal and indicated that he would be willing to make a personal contribution. This, of course, would be accepted with gusto but what we want now is to get the work under way on this instrument so that it can be used during the coming active season, beginning the middle of March.

Sincerely,

ORIGINAL SIGNED BY
S. B. ECKERTSBE:r
encl.

bc: Dr. Froelich G. Rainey ✓

Archdgd Techniques

March 29, 1961

Mr. Ford L. Johnson
Sun Oil Company
1608 Walnut Street
Philadelphia, Pennsylvania

Dear Mr. Johnson:

Here is the memo of my phone conversation with Mr. McDermott this morning.

As you know, I met with Messrs. McDermott, Dunlap, Romberg and others in Dallas about the first of February. At that time there was great surprise and enthusiasm with results of Linington's experiments and, in that meeting, the question of the commercial application of a new shallow depth instrument was brought up. I cannot remember just what Mr. McDermott himself said about the commercial application, but I do remember his saying finally that we were really there to discuss the archeological application and we should get on with that.

In the phone call today he said he did not think that G. S. I. was the organization to design the hardware, that all of the men there were primarily interested in their own job (that is, oil exploration), and that there was nobody really willing to put his mind to an archeological instrument without commercial application since there really was no market for archeology. He said he thought this should be developed by somebody in a university and suggested Mr. Howell, Head of the Geophysics Department at Penn State. He said that he had previously tried to get some research done in his own organization, which did not have to do with the commercial product, and did not work very well. He said that he did not think it would be very expensive to develop a high frequency impulse and that somebody in the universities interested in archeology should do this.

He asked me what I had learned about Humble's development of a new source for high frequency impulse and I said I'd gotten into a deadend there. He seemed very much interested in this and asked me to keep in touch with him. He also said he did not expect us to have paid the \$4000 which we sent to G. S. I. and that he would make a contribution to our work here in developing the instrument.

All the conversation was very friendly and he left no doubt that he felt our investigations with them so far had been successful and that he felt there was a good possibility of developing the high frequency instrument, although he said this would take time.

As you know, this was a complete surprise following our meeting in Dallas, when all of the conversation was directed toward getting on with the development of a new instrument at Texas Instruments.

Regards,

Froelich Rainey
Director

FR/sj

SUN OIL COMPANY

Archaeological
Techniques

COPY

April 5, 1961

Jde

Mr. Eugene McDermott
Texas Instruments Company
13500 North Central Expressway
P.O. Box 1079
Dallas 21, Texas

Dear Gene:

I have been looking at a portion of a file and we have had some conferences with regard to the work that has been going on between the University Museum of the University of Pennsylvania and Texas Instruments Inc. in attempting to develop an underground exploration apparatus for archaeological work. This as you know, has been an "off again, on again" matter which at the present time seems to be somewhat on high center. One of the more recent suggestions seems to have been that an instrument might be developed by someone in a university and the name of Howell, head of the geophysics department at Penn State University has been mentioned. None of us here feel that the University would be equipped to build a device for prospecting, as well as an organization of your kind could do.

The files show that you, in conversation with Dr. Rainey, mentioned commercial application of high frequency acoustic equipment. We have no idea as to what these may be but the thought does occur to us that Texas Instruments might have some ideas along this line and consequently might be reluctant to have Sun Oil's technical people participate as they have the in the past in the discussions. It also occurs to me that since Mr. Linington with the University Museum, is a physicist who incidentally I understand, has been making pretty much of a Cook's Tour through your entire plant, would also present some reason for reluctance by his presence.

I am wondering if Texas Instruments would take a different attitude toward proceeding with this work if Sun Oil's technical people and in fact any representative from Sun Oil Company, as well as Mr. Linington would withdraw completely from any discussion whatever with regard to this undertaking. It seems that considerable enthusiasm was displayed for the undertaking on several occasions in the past and we certainly do not want to do anything to curb this enthusiasm. Furthermore, we have no desire to learn anything about Texas Instruments' undertakings of this nature that might have commercial applications, because we recognize this would not be

To Mr. Eugene McDermott

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April 5, 1961

fair to you and to your people. It is no secret that Sun Oil is doing considerable amount of work on prospecting devices and it probably was wrong that our people should have advised with your people in the discussions that were had in the past, but I can assure you we have no ulterior motives in that regard.

Sun Oil Company is celebrating its 75th Anniversary and in commemoration of this event Bob Dunlop and the Senior Vice Presidents of the Company are visiting all units within the Company where we can assemble a concentration of people. We are having a big shindig in Dallas on Saturday, April 29th and in anticipation of this banquet I am leaving Philadelphia on Wednesday, April 26th for Dallas and will be there on Thursday, Friday and Saturday. It occurred to me that purely for the purpose of a conference with you, I might invite Dr. Rainey to come with me on my schedule in the event it would be convenient to have a visit with you.

As you know, Dr. Rainey is not a physicist but is an archaeologist and an anthropologist and as for me, I am the same technically untrained person that you knew twenty-five years ago except for a few telling years that have been added on. The purpose of our meeting would be only to try to get the show on the road and have it completely in the hands of Texas Instruments. Any ideas that you would come up with that have commercial applications would be entirely Texas Instruments and Sun Oil Company would most willingly execute any waivers that you would desire.

I hope a short visit can be had between the three of us and anyone else you might desire and I am looking forward to such a visit.

With best regards always, I am

Very truly yours,

Jack

JGP:r

cc: Dr. Froelich Rainey
Mr. S. B. Eckert
Mr. F. L. Johnson

Archaeological Techniques

May 19, 1961

Mr. Jno G. Pew
Vice-President, Production
Sun Oil Company
1608 Walnut Street
Philadelphia 3, Pennsylvania

Dear Mr. Pew:

Many thanks for yours of May 15th and your impressions of our meeting in Dallas. Here is what we have done since our conversations there.

There is an electronics technician in the Physics Department here at the University named Gray McLouchlin, who is very much interested in the possibilities of high frequency seismic equipment for archaeology and so I have gone ahead with Mr. McDermott's contribution of funds putting him to work on what he calls a "bread board" instrument. He is optimistic and very much interested in the idea and believes he can get something together to test the idea in a few weeks time.

However, I have even more faith in Mr. Johnson and his idea of getting the Petty Geophysical people really working on this thing and at his suggestion have written a letter to Mr. Hasbrook of that Company in San Antonio, explaining what we wish to do and noting that Mr. Johnson will be in touch with him shortly. It was Johnson's suggestion that I write him to demonstrate our long term interest in this project.

Mr. Jno. G. Pew
May 19, 1961
page 2

Incidentally, I am meeting , in my office on the first of June,
with the people of the other Universities to brief them on our
techniques work and we would all enjoy having you join us here
at the Museum for lunch, if you could manage it.

Sincerely yours,

FR:ah

Froelich Rainey
Director

SUN OIL COMPANY

1608 WALNUT STREET

PHILADELPHIA 3, PA.

JNO. G. PEW
SENIOR VICE PRESIDENT

May 15, 1961

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

Dear Dr. Rainey:

I am sorry for the delay in my reply to your letter of May second.

You ask me to satisfy your curiosity over what I think of the results of the luncheon meeting we had in Dallas on Thursday, April twenty-seventh. It is rather hard for me to sum up an answer that has any definite conclusions. Frankly, I was rather pleased over the discussion that was participated in mainly between Mr. Eugene McDermott and Mr. Fred Mayes and yourself. I got a little lost from time to time and it was for that reason that I urged Fred Mayes to write up a Summary of experience and discussions that have been had in the investigation of Seismic Methods for Archaeological Exploration. Fred has sent me such a report dated May ninth and I am enclosing a copy herewith for you and I am sending a copy to Sam Eckert.

Getting back to my impression of the discussion, I can say only this, that I am quite certain that Eugene McDermott and Fred Mayes are very anxious to help any way they possibly can in giving expert consultation from time to time and there is no doubt in my mind but that McDermott will be glad to do anything he possibly can to call in expert advice on the part of the members of the staff of G.S.I. and Texas Instruments. He has shown his generous interest with the financial contribution he has made toward the work you are doing.

In the meantime our Mr. F. L. Johnson and his associates have been in touch with Petty Geophysical in the hope of interesting them in this work. Whenever we hear from Petty we will let you know.

It was a real pleasure to me to have the opportunity to visit with you, particularly on our flight to Dallas and I, in



PIONEERING PETROLEUM PROGRESS FOR 75 YEARS

To Dr. Froelich Rainey

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May 15, 1961

my untutored way, will be very glad to assist from time to time in what you are trying to accomplish, with the hope that we can get the results you are looking for.

You will note from Fred Mayes' report that Dr. Linnington has not returned from Guatemala and will not return until June. I am hoping that after he has conferred with our people in Dallas that we will get another report from Fred Mayes and I would like to see Dr. Linnington's report to you also.

With kindest regards, I am

Very truly yours,

A handwritten signature in dark ink, appearing to be the name "Jack", written in a cursive style.

JGP:r

cc: S. B. Eckert
F. L. Johnson
Fred Mayes

Angel Techniques

May 2, 1961

Mr. Jno. G. Pew
Vice President
Sun Oil Production
1600 Walnut Street
Philadelphia 3, Pa.

Dear Mr. Pew:

I am very curious to know what you think of the results of our lunch in Dallas last Thursday. It seems to me that Mr. McDermott really wants to help in developing this thing, but does not think it is practical to have the Texas Instruments people involved in designing an instrument at this point. In any case we will go ahead here at once designing a high frequency source and some kind of ground couple and then I hope we can try this out somewhere with high resolution equipment supplied by Texas Instruments. Also, I've cabled Linington to stop off in Dallas and report the results of his work at Tikal so that they can keep in touch there with what we are doing. I will also write Mr. McDermott from time to time to tell him how we are getting on.

Believe me, I really appreciate the time and trouble you took with this and I enjoyed our flight out to Dallas. This certainly was by far the most pleasant of the several flights I've made out there in the last couple of years, and this will also express the thanks of the Board of Managers and the staff for the contribution of \$226.49, which you have contributed to the Techniques Program of the Museum. All of us appreciate it very much and I hope that within the next two or three years you will have the satisfaction of seeing geophysical techniques revolutionize methods in archaeology.

INTER-OFFICE CORRESPONDENCE SHEET

SUN OIL COMPANY

Archaeological Techniques

F. L. JOHNSON

SUBJECT: Application of Seismic Techniques to
Archaeological Exploration

DATE: June 7, 1961

FROM: Jno. G. Pew

OFFICE: Philadelphia

Fred M. Mayes

To: Mr. Fred M. Mayes
Dallas, Texas

Dear Fred:

Thank you so very much for your letter of May 25th reporting on the visit you and Larry Johnson had with the Petty Geophysical people and also on the brief discussion you had with Dr. Linnington who was in Dallas enroute from Guatemala to Philadelphia. I am making copies of your memorandum for Dr. Rainey and for our Mr. S. B. Eckert, just so everyone's file will be pretty well up-to-date.

I would have answered your memorandum sooner but as you know, Bob Dunlop and I have been on quite a trip through Mississippi, Louisiana and East Texas in commemoration of Sun Oil Company's 75th Anniversary and your letter came while I was away.

Very truly yours,

Jack

JGP:r

cc: F. L. Johnson

Frederick Rainey

S. B. Eckert

Both feel that development of high frequency or continuous equipment will require some time even if considerably urgency is assigned to the project, and certainly there is no possibility that this equipment will be available for the work proposed in Italy this summer. However, much useful information can be obtained by further field use of the simple equipment which was used in the Arizona tests, both in the evaluation of this specific equipment and in providing information regarding velocity variations to be expected in the archeological application. We recommend that this equipment be purchased and used in Italy if this work can be fitted in with Dr. Rainey's program.

Very truly yours,

Fred M. Mayes

Fred M. Mayes

F.L.J.

cc: Mr. F. L. Johnson

RECEIVED

MAY 29 1961

INTER-OFFICE CORRESPONDENCE SHEET

SUN OIL COMPANY

F. L. JOHNSON

SUBJECT: Application of Seismic Techniques to
Archeological Exploration

DATE: May 25, 1961

FROM: Fred M. Mayes

OFFICE: Richardson Lab

TO: Mr. Jno. G. Pew

Dear Sir:

This memorandum is a report of discussions regarding this work subsequent to my memorandum to you dated May 9.

Mr. F. L. Johnson and I visited the Petty Geophysical Engineering Company on May 22 to present this problem to Petty and to see if they were interested in undertaking development of high frequency or continuous wave equipment for the archeological application. As a result of this meeting, Petty agreed to submit a proposal outlining the specific approaches they consider desirable and including a rough estimate of the cost and time required for this work.

On May 24, Dr. Linnington arrived in Dallas enroute from Guatemala to Philadelphia. Mr. Johnson and I had a brief discussion with him and then went with him to GSI where we met with Dr. Fred Romberg. Dr. Linnington had done very little seismic work on the Guatemala trip. The seismic equipment he took with him was not the same equipment he had successfully used in Arizona, and certain features of the new equipment made it extremely difficult to use in this application. After some preliminary work, this new equipment became inoperative, and as a result Dr. Linnington was not able to make seismic studies in Guatemala. There was a short discussion of instrumental requirements for this application, but Dr. Romberg indicated that GSI did not desire to undertake an instrumental development program.

Mr. Johnson and I both feel that development of high frequency or continuous wave equipment will require some time even if considerably urgency is assigned to the project, and certainly there is no possibility that this equipment will be available for the work proposed in Italy this summer. However, much useful information can be obtained by further field use of the simple equipment which was used in the Arizona tests, both in the evaluation of this specific equipment and in providing information regarding velocity variations to be expected in the archeological application. We recommend that this equipment be purchased and used in Italy if this work can be fitted in with Dr. Rainey's program.

Very truly yours,

Fred M. Mayes

Fred M. Mayes

FMM:be

cc: Mr. F. L. Johnson

June 13, 1961

Mr. F. L. Johnson
Director, Production Research
Sun Oil Company
1608 Walnut Street
Philadelphia 3, Pennsylvania

Dear Mr. Johnson:

We are pleased to present the attached proposal for development of a Sonic Archaeological Probe along the general lines discussed during your recent visit.

As you will recall, we feel that we should obtain clearance from the Subscribers to our high frequency seismic research project, in which Sun is participating, before starting on the proposed program. There should be no difficulties in arranging such approval as soon as the program is firmed up somewhat.

We appreciate the opportunity to present this proposal, and look forward to working with you and Dr. Rainey on this interesting project.

Very truly yours,

PETTY LABORATORIES, INC.

W. Harry Wayne
Vice President, Technical Operations

WBM:es

June 16, 1961

Philadelphia

F. L. Johnson

Mr. Jno. G. Pew

Dear Sir:

This memorandum covers our conversation of this morning concerning the proposal submitted by the Petty Laboratories Inc. for the development of acoustic methods for archeological prospecting. A copy of the Petty proposal is attached.

As I have expressed previously in conversations with you, Mr. Eckert, and Dr. Rainey, I have felt acoustic methods could provide valuable prospecting tools for archeologists. It is my belief, and that of Fred Hayes, that the experimental field work which was conducted with the Texas Instruments so-called high-resolution seismic equipment demonstrated conclusively that shallow reflections and refractions can be observed from shallow objects. It was also demonstrated that the presently available equipment designed primarily for the location of bed rock is also useful. It should be noted, however, that neither apparatus was designed for the purpose we have in mind. The fact that we did get successful indications leads me to believe that equipment tailored to the problem should provide much superior resolution, particularly in the location of relatively small objects.

I am also of the belief that the development of this equipment should be in the hands of people thoroughly experienced in seismic methods and apparatus. The apparatus must necessarily include means of generating acoustic energy, coupling it into the soil, and detecting the returning energy. Although specialists in electronics might be available at a university, an understanding of the acoustic coupling and transmission problems would most likely be lacking. This would be a severe handicap. Since the design of suitable equipment does involve research and development, I have never been of the opinion that we could find means to accomplish this without the expenditure of a sizeable amount of money.

The Petty proposal would, most importantly, increase the frequency range of the sonic energy, and would in fact determine the optimum ranges for variables we are dealing with. In fact, if I may recall to you, Sun Oil, along with six other companies, has been supporting Petty for the past two years in determining the properties of the surface layer at higher frequencies than those normally employed in seismic prospecting for petroleum. In this program they have studied frequencies as high as 5,000 cycles. For the archeological problem the range would be extended to

Mr. Jno. G. Pew

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June 18, 1961

10,000 or 15,000 cycles. A considerable portion of the information developed by Petty in this joint venture will provide background information and test data which will bear directly on the archeological problem. This might be termed a "contribution" from all of the participants, such as us, who have supported the Petty research investigation.

Although the estimates submitted by Petty add to the sizeable amount to \$92,000, this expenditure should establish, once and for all, the feasibility of this method. I personally am quite convinced that a useful apparatus can be developed. I also believe that Petty's estimate of these research and development costs is not at all unreasonable. I do not know whether support at this level can be developed for this project. If not, I would have no further recommendation of my own, other than to abandon the project, and use the presently commercial equipment which is useful, but undoubtedly limited in many respects. I recommended to Dr. Rainey that the apparatus obtained by Limington for the tests in Texas and Arizona be purchased for approximately \$1,800, and used during this summer's expedition to Italy. The use of the Texas Instruments equipment is not feasible in its present form.

Very truly yours,

FLJ:es

Enc.

CC: Mr. S. B. Eckert (w/enc.)
Dr. Froelich Rainey "

CROSS REFERENCE SHEET

Name or Subject

File No.

ARCHAEOLOGICAL TECHNIQUES

Regarding

Date

A Personal Anonymous gift the
Seismic Fund from the John G. Pews.
100 shares of Sun Oil Stock

August 3, 1961

SEE

PEW

Name or Subject

File No.

File cross reference form under name or subject at top of the sheet and by the latest date of papers. Describe matter for identification purposes. The papers, themselves, should be filed under name or subject after "SEE."



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For use in all Filing Systems

INTER-OFFICE CORRESPONDENCE SHEET
SUN OIL COMPANY

SUBJECT:

DATE: October 5, 1962

FROM: F. L. Johnson

OFFICE: Newtown Square

TO: Mr. Jno. G. Pew

Dear Mr. Pew:

This is written in comment on the report forwarded to you by Dr. Froelich Rainey, Director of the University Museum. I was very much interested to learn of the scope of archeological activities being pursued by the University Museum. It would seem that this program represents a real effort to apply most of the newer techniques of measurement and analysis to archeological problems. This is the goal which we discussed with Dr. Rainey and Mr. Eckert. Each archeological site may be expected to present a different problem, and require a different solution. Hence, it is important to have available a variety of tools and techniques with the hope that one or more will provide exploratory leads.

With respect to the problems of archeological exploration, the work in Italy is of particular interest. Here, the magnetometer provided (to me) an unexpected bonus. It turned out that the surface soil had a relatively high concentration of magnetite (iron oxide) which rendered it magnetic, while the rocks (presumably limestone) of the walls and houses were quite non-magnetic. This made it easy to map on the surface the configuration of shallow archeological features. This fortunate situation may not exist in another situation, rendering the magnetic method useless. Where applicable, the magnetic method has the virtue of hand portability making it extremely easy to survey in the field.

The method of electrical resistivity was employed quite successfully by Dr. Rainey in Mexico at a site where, I understand, it is arid and the surface ground waters are below the depth of interest. It is well known that resistivity methods are particularly sensitive to the distribution of ground waters, and in many places would be worthless for this reason.

Because of the limitations of the magnetic and electrical resistivity methods, the writer recommended that sonic methods be investigated with the hope that this method could supplement the others and perhaps work under conditions where other methods would be useless. It should be recalled, and re-emphasized that to my knowledge, this problem has never been explored. Although a relative of seismic geophysics as applied in deep penetration exploration for sub-surface structure, the problem of locating very shallow objects is, to the best of my knowledge, completely new. Consequently, this problem calls for a program of basic research.

Mr. Jno. G. Pew
Page Two
October 5, 1962

It is necessary to investigate the absolute fundamentals of coupling energy into soft surface soils and picking up reflections at the surface. This involves the determination of useful frequencies, power requirements, transmitting means, coupling methods, and detectors. These things must be determined from scratch, which explains my dubious attitude towards the approach initiated by McLaughlin. As I tried to make clear, the instrument developed by him is excellent, but he did not have the pre-requisite information of the basic physics involved. His instrument did not provide sufficient energy at the appropriate frequencies to permit adequate penetration.

The Petty Geophysical Company is starting from the start in attempting to understand the fundamentals. Since this is research, it should be emphasized that the results cannot be predicted. Their mid-summer report indicates that very little energy is coupled through loose soil at frequencies above 500 cycles per second. This limits the size of objects which can be detected to about two feet (in diameter) or greater. Although this is a limitation, it is not severe, as I understand the problem. Power requirements have not yet been determined, but it may turn out that the equipment will not be hand portable, but will require a small truck for transport. The approach being taken by Petty seems to be sound and should determine just what form and size are required for equipment to be of use in archeological exploration.

I would be pleased to discuss this with you in greater detail at your convenience.

Very truly yours,


F. L. Johnson

FLJ:nf
Enclosure

SUN OIL COMPANY

1608 WALNUT STREET
PHILADELPHIA 3, PA.

JNO. G. PEW
SENIOR VICE PRESIDENT

October 11, 1962

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

Dear Fro:

Upon receipt of your letter of October second I forwarded it immediately to Larry Johnson, who now has his office at our Newtown Square Laboratory, and Larry has written me his letter of October fifth. In the event you did not receive a copy, I am sending a copy to you as well as a copy to Mr. Sam Eckert.

You were very nice to send me the Final Report on the Research and Development in New Techniques for Archaeology.

With best wishes, I am

Sincerely yours,



JGP:r

cc: F. L. Johnson
S. B. Eckert

Techniques

June 15, 1963

Mr. Jno. G. Pew
Sun Oil Company
1608 Walnut Street
Philadelphia, Pa.

Dear Jack:

I am just back briefly in the office from Italy and expect to return and finish up the job there this month, but I note your letter to Larry Johnson with comments on the research at the Petty Company and thought I ought to fill you in on where we stand at the moment.

The sonic device, rebuilt by Gray McLaughlin here in Philadelphia, was returned to us at Sybaris in May. Even though he got much more power for transmission into the ground, the instrument still does not function. The problem quite certainly is the ground coupling. Therefore, we are anxious to have the results of the Petty Company research to see if they can't lick the problem of ground coupling. It was our hope that with Edgerton's "Boomer" we might get the Petty Company to do some testing at Sybaris, but apparently they are not ready for that as yet. With luck we should have some sites in this country to test their equipment this fall.

At Sybaris we have pretty well outlined the port of Sybaris and also discovered a Greek city twenty kilometers inland which might be Sybaris itself, but I am doubtful about this and won't know until we do some digging there during the rest of this month. Professor Meyerhoff, the new head of the Geology Department here at Pennsylvania, is right now examining the area from a helicopter, and also examining the hundreds of soil samples we have taken with the geophysical drill. Lerici and I are anxious to finish this job this summer so we can move on to a very promising site for testing our instruments in Bulgaria.

I ran into Howard Pew on the train the other day. He tells me you are back at work, which I am very glad to hear.

Very best wishes to you,

Dr. Froleich Rainey
Director

fit

May 14, 1963

Jno. G. Pew

Philadelphia

Mr. F. L. Johnson
Richardson

Dear Larry:

It is so good to have your letter of May 9, 1963, and to have your comments on the March report of the activities of the Sonic Archeological Probe at the Petty Laboratories. I am making a copy of this letter and sending it to our friend, Fro Rainey, at the Museum. I am sure he will be glad to have your ideas.

King, Dick and Sam have all reported to me on how well they thought you looked and what wonderful progress you seem to be making down there. We are all fighting with you to see that everything works out o.k. and know that you are giving things everything you have got, too.

Ted seems to be getting along real well. Over the weekend he let go of two of his nurses and has only the morning nurse now. How long he will be in the hospital none of us know, and there is still a "No Visitors" sign on his door. Since he has not mentioned anything about this, none of the rest of us are saying anything either. As you know, if we let the bars down for Ted he would think he ought to get in high cotton all at once.

With love to Bernice and best to you, I am

Sincerely yours,

JGP

JGP:w

cc: Dr. Froleich Rainey
University of Pennsylvania Museum
36th and Spruce Streets
Philadelphia, Pa.

INTER-OFFICE CORRESPONDENCE SHEET
SUN OIL COMPANY

SUBJECT:

DATE: May 9, 1963

FROM: F. L. Johnson

OFFICE: Richardson

To: Mr. Jno. G. Pew
PHILADELPHIA

Dear Mr. Pew:

The following comments are offered concerning the March report of activities on the Sonic Archeological Probe at the Petty Laboratories.

This report mentions the first results using the high power sound transmitters obtained (on loan) from Dr. H. E. Edgerton. These tests were somewhat disappointing in that the frequency of the shallow reflection was lower than had been hoped for. However, this may be improved by further experimentation with methods of coupling these power sources to the earth. These studies should yield data which will help to specify a sound transmitter designed specifically for this work.

From the work to date, it would appear that the field apparatus would have to be mounted in a light or medium sized truck and that it may be necessary to "plant" the sound source and detectors in shallow holes (one or two feet deep) in a line twenty to thirty feet long to probe for buried objects over a range of ten to twenty feet of distance. These holes could be quickly dug (or pressed) by auger or hydraulic equipment mounted on the same truck. While this would be cumbersome and would not approach the hand portable operation of the magnetometer equipment, it would still be a vast improvement over actual exploratory excavations. The aim is, of course, the location of objects which are not revealed by the magnetometer.

All of the work to date clearly shows that the basic consideration lies in understanding the problems of coupling (or transferring) sound energy to the surface soils. The work at the Petty Laboratories represents, in my opinion, the first attempt to obtain quantitative data concerning this and thus outline the uses and limitations of this method of archeological exploration.

Very truly yours,


F. L. Johnson

FLJ:be

cc: Mr. P. E. Chaney
Mr. F. M. Mayes

Petty Laboratories, Inc.

San Antonio, Texas

SONIC ARCHAEOLOGICAL PROBE

Report of Activities

March 1963

A control unit was constructed with provision for 12 detectors with separate batteries. The truck wiring was modified for multiple spread detector arrangement.

On the 11th of March, the "Boomer" power supplies and transducers arrived, furnished thru the courtesy of Dr. H.E. Edgerton of Edgerton, Germeshausen and Grier, Inc. Included were two 500 watt experimental and one 1000 watt transducers.

Holes were dug as near as practical to the shallow and deep vertical detector arrays for the 1000 watt transducer. Previous driver holes in centers of the detector arrays were used for the smaller 500 watt transducers. Driver holes were lined with thin plastic material to prevent loss of coupling fluid.

Transducers were tried with both shallow and deep vertical detector arrays and the seismic energy recorded. The records indicate lower frequencies than 600 cps are produced.

Dynamite caps were also fired in water filled center driver hole with the detector array. Recordings of the seismic energy were very similar to those produced by the "Boomer" transducers.

The "Boomer" system is an excellent source of high power acoustic energy, but the results so far indicate seismic signals of much lower frequencies than 600 cps. Apparently the initial pulse of the "Boomer" transducer in

water is either altered or suffers high frequency attenuation in the earth medium. Previous results of impulsed continuous wave seismic recording indicates a gradual build-up of 600 cps energy thru about 3 or 4 cycles. A pulse of discrete frequency is desirable in the region of 600 cycles.

Further work is in progress using horizontal spreads of detectors spaced along the optimum angle with the "Boomer" transducer to attempt to obtain reflections from a concrete target 3 feet in diameter and 25 feet deep. Detectors and transducer moving along an axis over the target will be tried.

SUN OIL COMPANY

1608 WALNUT STREET
PHILADELPHIA 3, PA.

JNO. G. PEW
SENIOR VICE PRESIDENT

Schneidgen
T. H. H. H.

November 7, 1962

Mrs. John Dellevigne Jr.
Secretary to Dr. Rainey
The University Museum
33rd and Spruce Streets
Philadelphia 4, Penna.

Dear Mrs. Dellevigne:

Thank you very kindly for forwarding to me the
report from the Petty Company concerning their work on sonic
instruments. As you suggest I am forwarding it to our Mr. F. L.
Johnson for his perusal.

Very truly yours,

Jno. G. Pew

JGP:r

cc: Mr. F. L. Johnson

INTER-OFFICE CORRESPONDENCE SHEET
SUN OIL COMPANY

SUBJECT:

DATE: November 5, 1963

FROM: Jno. G. Pew

OFFICE: Philadelphia

TO: Mr. F. L. Johnson
Richardson, Texas

Dear Larry:

Thank you so much for your letter of October 29th reviewing the discussion that you, Dr. Rainey, Mr. Eckert and I had when we were all together in this office on October 16th; this of course being on the status of the archeological sonic probe project which has been under development at the Petty Geophysical Engineering Co. in San Antonio, Texas.

I am sending a copy of this letter to Allyn Bell for his interest and also to remind him to put this project on the Agenda for the next meeting of the Committee on Grants of the Pew Memorial Trust. In doing this of course, there is no commitment except that we will discuss it at our meeting in November.

Very truly yours,

JGP:r

cc: Dr. Froelich Rainey ✓
Mr. S. B. Eckert
Mr. A. R. Bell Jr.

Arch.
Tech.

November 20, 1963

Dear Jack:"

I do not know whether you received one of these final reports on the work by the Petty Company, but in case you did not, here is one of the three sent to my office.

Was there any comment about this proposition at the Foundation Board meeting last Monday? Perhaps, I should talk with Sam to decide on the next move, but if you have any ideas, I certainly would appreciate them.

Very best wishes,

Froelich Rainey
Director

Mr. Jno. G. Pew
1608 Walnut Street
Philadelphia 3, Pennsylvania

EUGENE MCDERMOTT
13500 NORTH CENTRAL EXPRESSWAY
P. O. BOX 5474
DALLAS 22, TEXAS

January 4, 1964

ME
Arch
Relinquish

Mr. John G. Pew
1608 Walnut Street
Philadelphia, Pennsylvania

Dear Jack:

I suppose you have given up on hearing from me about the seismic applications in the archaeological area. Our staff has been studying the Petty report, and another report came in, meanwhile, which I also gave them for study (more about this later.) When you add to this the confusion of the holidays, maybe you can understand why I am a little late.

To review a little of the history of this project, I remember that you and I met with Dr. Rainey a few years ago. I felt at that time and I still do that this kind of project is not one which should be submitted to a large company. It was my suggestion then that Dr. Rainey find a man who would be a practical, experimentally-oriented person with some theoretical understanding, the idea being that with a little theoretical understanding on this person's part, he could communicate with our staff and so get all the theoretical support necessary in such a project as this. I felt this way because I thought it would be the most economical and best way to get a piece of equipment in the field that would work and with this as a starting point any improvements necessary for more effective operations could be made. Dr. Rainey was able to secure Gray McLaughlin whom I think fits the requirements. He has developed a piece of portable equipment which he has just reported on (and that is the report I refer to above.) This equipment fills the essential requirements of being portable, simple in operation, and economical, equipment- and operations-wise. He has made field tests and with some changes he should have a field-worthy piece of equipment. I have invested \$10,000 in this project so far and feel that we have accomplished a great deal.

One of the principal difficulties was getting good couplings for the receivers to the ground. This MacLaughlin accomplished in a very direct and simple manner by mounting his receivers on spikes.

Page 2
January 4, 1964

The Petty people accomplished this in a more complicated fashion. In fact, that was their only contribution in their report.

There has been a great deal of discussion of reflections in all these reports. Might I say that we had better, first, try to get good refractions, look for any abnormalities in the time or amplitude or wave forms of these refractions, and take any reflections that come along. There also has been a great deal of discussion of continuous waves. I feel this is quite premature, and we had better start with simple pulses generated simply by a dynamite cap or by a pistol.

In view of my analysis, I do not think it at all advisable to go ahead with the Petty proposal. This is horribly expensive and so far from being portable that I doubt that it would be much use on that basis alone...at least at the present state of development of the art in this area.

My feeling is that we should complete the MacLaughlin program to the extent of making the present set of equipment really field-worthy. Then we should send it to the field with someone such as MacLaughlin who is competent to ensure it gets started in the field. This should not take much money, and I would be willing to help support it. Would you like to join me in this?

I should like to say that no single kind of instrument is going to turn out to be the Open sesame in the solution of these archaeological problems. Neither one instrument nor group of instruments will prove to be the answer to all problems. Take, for instance, the great success the magnetometer had at Sybaris. This could not have been predicted in advance; the approach had to be purely empirical. I think this will continue to be the case.

Thus, I think the best procedure is to get the simplest and most economical piece of equipment of each of these types in the field and let the man in the field decide the best combination for their use.

Page 3
January 4, 1964

**With best wishes for the New Year for Berta and
yourself, I am,**

Sincerely,

Eugene McDermott

EMcD/nj
cc: Dr. Froelich Rainey

**P. S. I am returning, as an enclosure to this letter, the Petty
report.**

Techniques

March 25, 1964

Dear Jack:

I am just now back from the Near East, and note that you and Sam sent in those contributions we discussed on the phone for the development of the new rubidium magnetometer, and I simply want to thank you again for coming to our aid in a very tight situation. I expect to get another \$5,000 from the Wenner-Gren Foundation, and I have just been talking to the Atomic Energy Commission about a contribution to cover the balance. But in the meantime, the Varian Corporation has gone ahead rebuilding the thing, and I have ~~got~~ my fingers crossed hoping I can pay the bill when it arrives.

You may be amused to know that I have just been visiting ~~the~~ mother city of Sybaris in Greece, and the Greeks are urging us to have a crack at that also with our new instruments, but Orville Bullitt insists we must find Sybaris first.

There is no word from Eugene McDermott or MacLaughlin about our sonic device, but I shall look into that shortly. I hope that things are well with you.

The very best,

Froelich Rainey
Director

Mr. Jno. G. Pew
1608 Walnut Street
Philadelphia, 3, Pennsylvania

FGR/vg

also To: Lita Osmundsen

S. B. Eckert

John G. Rens

Francis Boyer

SUN OK

F. Rainey

October 14, 1965

MEMORANDUM

TO: F. Otto Haas

FROM: Froelich Rainey

SUBJECT: Rubidium magnetometer

I am very pleased to advise all of you who have helped to finance the development of our archaeological magnetometer, that our serious field tests of the new instrument at Sybaris, in south Italy, last week, were a great success.

When the Varian Associates engineers set about re-designing the rubidium magnetometer for archaeological purposes they decided to substitute cesium for rubidium in the sensors so we now have a cesium magnetometer as our latest development.

On the plain of Sybaris we found that we could carefully cover about ten acres a day and that we could easily pick up structures lying more than six meters deep. Moreover, the new instrument is steady, highly dependable, and much more precise than the rubidium magnetometer. We figured that it is at least four times more efficient than any other instrument we have tried.

I now feel quite certain that we have located the ruins of VIth century B. C. Sybaris, but it will take some months to prove it out. There is still a problem in that on certain terrains no magnetometer can be used successfully for archaeology. But at least we now have an instrument which on the right terrain, can be used to explore large areas for unknown sites.

I hope that this instrument can be used for other purposes and can then be put into production so that the price will be more reasonable, for archaeological use. But this is something that we are going to have to work out with the Varian Associates.

The field testing last week was a tremendous satisfaction.

Arch, JNO. G. PEW
Teddie JNO. G. PEW
Senior Vice President

GENERAL OFFICES **SUN OIL COMPANY** 1608 WALNUT STREET, PHILADELPHIA, PENNSYLVANIA 19103

October 27, 1965

Dr. Froelich Rainey
The University Museum
33rd and Spruce Streets
Philadelphia, Pa. 19104

Dear Fro:

Thank you very much for your letter of October 15th in regard to your substituting cesium for rubidium in the sensors of the magnetometer.

I discussed this briefly with some of our scientists here yesterday and although they were familiar with rubidium they did not have quite as much knowledge of cesium, the element which I heard about only recently. Frankly, I am somewhat at a loss to be of much help to you and your archaeologists' work since the retirement of our mutual friend, Larry Johnson, who as you know, has not been well and is floundering around between Phoenix and Prescott, Arizona and the last word I had was that he was living back in Utah with his fellow Mormons. He just doesn't seem to be able to stay put!

Again congratulations on your successes in your work and although I am not very knowledgeable I still hope to be of some help to the work you are doing in a small way at least.

With best regards, I am

Very sincerely,

Jack

JGP:r

WENNER-GREN FOUNDATION FOR ANTHROPOLOGICAL RESEARCH
INCORPORATED

14 EAST 71ST STREET
NEW YORK, N. Y. 10021

CABLE ADDRESS: WEGEFOUND
TELEPHONE: REGENT 7-2900

September 30, 1965

Dr. Froelich Rainey
The University Museum
University of Pennsylvania
23rd and Spruce Streets
Philadelphia, Pennsylvania 19104

Dear Dr. Rainey:

Your letter to Mrs. Osmundsen arrived in her absence and I am taking the liberty of acknowledging it to you with thanks. We are glad to learn of the success of the magnetometer and will be pleased to inform Mrs. Osmundsen of this, as well as your itinerary for the month of October.

Sincerely yours,

Muriel Lipit

(Mrs.) Muriel Lipit,
Coordinator
Research Program

*file
Wenner-Gren*