

PHYSICS DEPARTMENT

October 6, 1966

Dr. H. Callen, Building Chairman
Dr. K. Atkins, Acting Chairman, Physics Department

Additional space, approximately 20x20 feet, preferably with water and an exhaust hood, is requested for the Radio-carbon Laboratory (now in Rooms BW4 and BW6).

A request is being submitted to the NSF for funds to support some new experiments with thermoluminescence and electron spin resonance as means of detecting radiation damage from C^{14} betas. This may lead to a new way to determine the half-life of C^{14} and for archaeological and geological dating of natural C^{14} .

Some experiments with more active C^{14} (probably below 50 μ c) will have to be performed. For this reason and the fact that our two rooms are already crowded, space outside of our low-level laboratory is requested. It is anticipated that these experiments will be started in May or June, 1966.

Elizabeth K. Ralph

EKR:pc

ASCA SPACE REQUIREMENTS

In University Museum -

Space Presently Allocated -

1 room	16ft.	x	12ft.	, Information Center
1 "	16	x	32	, Tree-Ring Dating, Work benches and shelves for instruments, and part of Thermoluminescence
1 "	16	x	17	, Remainder of Thermoluminescence and Misc. activities of chemist or physicist
1 "	6	x	12	, equipped with sink for chemical experiments and miscellaneous washing
1 "	20	x	20	Museum Chemist (Eric Parkinson)

Space Required -

1 room	20 x 20	for adequate work space for present activities, including drafting table or equivalent large bench and additional desk
2 rooms	20 x 20	for metallurgical - archaeological training program; laboratory sink required.
2 rooms	20 x 20	for permanent magnetism studies. This will require special power line (30 amps) direct from main transformer. Sink required.
1 room	6 x 12	for fumigation of Museum collections; room to be sealed and provided with exhaust.

In Dept. of Physics -

Space Presently Allocated -

2 rooms 20 x 20 for Radiocarbon Laboratory

Needed

1 room 20 x 20 with shelving for storage of samples and
supplies and workbenches for repair and
building of equipment.

For use for foundation support for new wing
4/13/67

APPLIED SCIENCE CENTER FOR

Archaeology (MASCA)

The Applied Science Center for Archaeology was initiated in 1961 by Dr. Froelich Rainey. Its aim is to apply new principles and technologies developed in the physical sciences which are appropriate to archaeological and anthropological research.

Upon the successful application of carbon - 14 dating in the laboratory here (established in 1951) and in others, it was felt that many more of the technological advances should be investigated for possible applications. As a beginning in this direction, work was started in the following fields:

- 1) Thermoluminescence dating of pottery
- 2) Development and use of instruments for archaeological prospecting.
- 3) Information Center and Newsletter.

Since then, the existing chemistry laboratory has been expanded to include a much more active program of conservation and restoration. Also, work in dendrochronology is being pursued to provide samples of known age for C-14 dating.

In the following pages a brief description of the various endeavors of MASCA is presented.

Incl. 3 anthro
archives
Eric's

Thermoluminescence

Research in the possibility of using thermoluminescence for dating pottery was started here in 1959 and has been pursued actively since 1962. Significant progress made during the past two years indicates that the method will be a reliable one, possibly comparable ⁱⁿ accuracy to C-14 dating or better. It has the big advantage over C-14 dating in that the artifact itself (a few milligrams of pottery) is dated rather than charcoal or other carbon sample that is merely and sometimes erroneously associated with the occupation level to be dated.

The method is based on the fact that particles from traces of radioactive elements in clays bombard the other constituents and raise electrons to metastable levels. When the clay is heated, enough extra energy is supplied to enable the electrons to return to normal states. In this transition each one emits a photon of light. The final heating of a ceramic is, therefore, the starting point of the metastable electron accumulation. In the laboratory, a few milligrams are ground, mounted, and heated very rapidly so that as much of the light output as possible is detected before the onset of heat radiation. This is detected by a photomultiplier tube, amplified, and recorded on an X-Y recorder versus temperature. For age determination, the rate of radioactive bombardment is also measured. In addition, the variations among clays in susceptibility to radiation damage is corrected for by artificial bombardment with X-rays and subsequent remeasurement of the glow curve.

Space is needed for the continuance of the development of this dating technique and for the dating of samples of unknown age.

Instruments for Archaeological Prospecting

With the destruction of many archaeological sites imminent due to the rapid encroachment of modern civilization, there is a great need for the acceleration of the finding of sites and for the delineation of structures within sites already found. Also, with the cost of labor increasing all over the world, it is becoming impractical to excavate unless there is a certainty that structures or levels of habitation will be found.

With this in mind, MASCA has tested and used instruments developed previously that are suitable for archaeological exploration. These include the Elsec proton magnetometer, the Gossen Geohm, and various metal detectors and seismographs. In the course of the search for the ancient Greek city of Sybaris, buried at depths of 4 to 6 meters, it was found that proton magnetometers were not sufficiently sensitive for the detection of structures or archaeological deposits at these depths. Therefore, the collaboration of Varian Associates was sought, and as a result, a more sensitive portable cesium magnetometer (with digital readout and differential mode of operation) was designed and developed by them. This has now been tested in two field seasons and has proved to be the ideal instrument for archaeological prospecting in regions that are normally magnetically quiet and where the features sought present some contrast in magnetism.

It was found that standard seismographs were of little use in finding the relatively small archaeological features, usually located above much more massive geological changes - the wavelengths are too long. Therefore, experiments

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Instruments (con't)

directed toward the development of a sonic instrument were conducted. Much information about the problems involved has been obtained, but a successful portable design has not yet been achieved.

In the MASCA laboratories some space is needed for storage of instruments while not in use and for experimentation, tests, and repairs.

Information Center

An extensive part of the work at the MASCA Information Center is the compilation of author and subject indices which form a catalogue of scientific techniques of value to Archaeology and Anthropology and include reports of analyses dating methods, field studies, and conservation methods. The abstracts of articles and references, and information on new developments which are the basic components of the files, are culled from many publications of diverse fields. The files are a source for the most recent information concerning archaeological techniques and include, in addition to published material, unpublished information, gathered from correspondence and experimental notes.

The Information Center, itself, now that a considerable volume of data have been collected, is becoming more useful to members of the staff, students and visiting scholars. ^{Much} More space is needed for the use of the files.

In addition to library and abstracting work/^aNewsletter is published three times a year, in which current developments in the field of techniques are reported. Copies are made available, free of charge, to all interested persons. The mailing list is world-wide, and the center receives notes and articles from many foreign sources.

Chemistry Laboratory

When a specimen is sent ⁱⁿ to the Museum from the field its identification often is only superficial. A chemical analysis, qualitative to establish the constituents of the specimen or quantitative to determine the relative amounts of these constituents, can help in more precise identification. If a specimen has been modified or drastically changed in appearance over a long period of time an analysis may be useful in deciding its original form or use. A chemical analysis may also be useful in helping to decide on the authenticity of an object, and sometimes an analysis is required merely to add to the sum of knowledge about a specimen. Specimens may be metals, ores, corrosion products, earthy materials, organic products, etc., and either archaeological or more recent in origin.

Space is required for adequate working bench surface, for wall cases and cabinets for storage of chemicals and apparatus, and for such equipment as sinks, fume hood, oven, furnace, and balance; also for a desk and bookcase for each worker. A large table or other flat work space for laying out drawings or maps is also recommended. The area presently in use is about 360 square feet, some of which is used alternatively for conservation procedures.

Dendrochronology

The tree-ring dating program is being conducted in conjunction with the radiocarbon laboratory. By means of dendrochronology, sections of Sequoia gigantea and of Pinus aristata are providing samples of known age for C-14 dating (back to 4400 B.C.). By means of these, small fluctuations in the atmospheric C-14 inventory in past times are being assessed. When the magnitude and duration of these are known, it may be possible to correlate these with one or more of the basic causes - namely, changes in the cosmic ray intensity, in the intensity of the magnetic field of the earth, and/or in the equilibrium conditions (the balance between the atmosphere and oceans). C-14 dates for these long series of samples of known age will also provide correction factors for the dating of archaeological specimens and others of unknown age.

The tree-ring dating is being done in collaboration with the University of Arizona. In the Museum space is needed for study, sectioning, and cross-dating of ring sections.

Carbon-14 Dating

The radiocarbon laboratory at the University of Pennsylvania was established in 1951. It is one of the few laboratories in the world that has devoted itself almost exclusively to the dating of archaeological and anthropological samples. During the past 15 years 562 C-14 dates representative of 113 archaeological sites have been published. Emphasis has been in the establishment of chronologies for four main regions of the world - namely, the Near East and Mediterranean regions, Central America, South America and the Arctic. Among intensive studies have been the correlation of the Mayan calendar with the Christian, dating of some of the earliest sites and elucidation of human migrations in the western Arctic, the dating of occupations and climatic sequences for what is apparently the earliest site in eastern North America, comprehensive dating programs permitting archaeological interpretation of Mesolithic-Neolithic-Chalcolithic transitions in the Near East and the Anatolian Plateau.

The radiocarbon laboratory is the keystone of MASCA. Because the laboratory and its main staff are supported by the University and partly because of their record of achievement, it has been possible to obtain grants from the National Science Foundation, industries, and private contributors to carry out new programs. One of the NSF grants supported the addition of a second C-14 counter and associated components for methodological studies as described under Dendrochronology.

The radiocarbon laboratory is considered to be among the most reliable dating laboratories in the world, and possibly the most careful. Partly because of this, requests for dating each year now exceed our yearly capacity even with some of

Carbon-14 Dating (con't)

the counting time of the 2nd NSF counter devoted to samples of unknown age.

There is, therefore, an urgent need for more space. This is not available in the Department of Physics where the laboratory is located at present. Also, because of the pressure for space, the laboratory may be forced to move from Physics to Geology where both space and facilities are inadequate.

With more space, a third counter could be installed. The electronic components presently in service have been in continuous use for eleven years - a long life-time for vacuum tube circuits. Therefore, in addition to more space, there is an urgent need for funds for their replacement and for the third counter and components. Cost of this is estimated to be \$50,000 plus the cost of this portion of the building.

List of MASCA Requirements .

Name of Laboratory	Space Required (square feet)
Thermoluminescence Dating	1000
Prospecting Instruments	300
Information Center	300
Conservation and Chemistry	1400
Dendrochronology	300
Carbon-14 Dating	<u>1200</u>
Total	4500 + hallways

Utilities Required in Each Room:

- 24 Electric Outlets, 115v, 15A
- 2 " " , 230v, 25A
- 2 Dual Gas Outlets
- 2 Dual Compressed Air Outlets

Sinks Required:

- 2 Carbon-14 Laboratory
- 2 Thermoluminescence Laboratory
- 2 Conservation and Chemistry

Fume Hoods Required (with small sinks and all utilities)

- 1 Carbon-14 Laboratory
- 1 Conservation and Chemistry

1970

CHEMICAL LABORATORY

37

E. Parkinson

(NOT MASCA)

39

~~Sink for~~
MASCA
general
contains drain
& air inlet

Chemical
Storage

36

Room No. SQ. FT.

36 (?) 88

37 377

39 69

41 187

40 193

42 361

44 193

34 372

43 254

45A 96

45 190

SQ. FT.
88
377
69
187
193
361
193
380
372
96
190

AERIAL PHOTOGRAPHIC

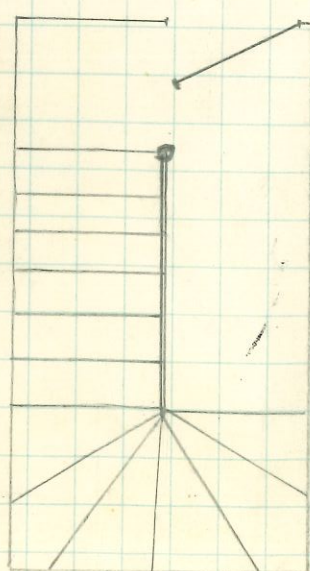
34

STORAGE

372 sq ft (NOT MASCA)

(No air in this room)

SCALE: 1/4" = 1'

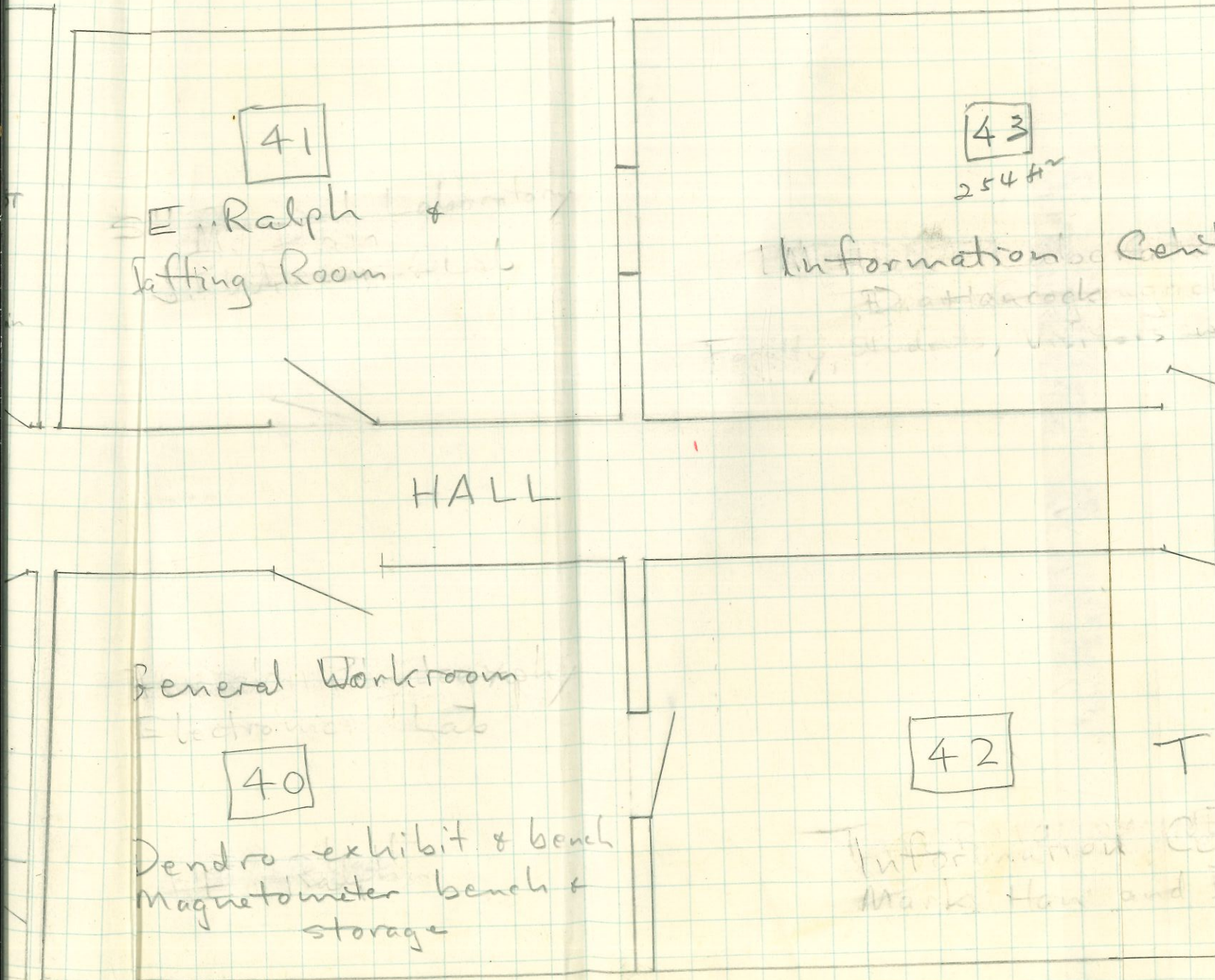


MASCA

SPACE REQUIREMENTS

DECEMBER 1970

CELL



G HEIGHT $\approx 10\frac{1}{2}$ FEET

OFFICE

43A

96 ft²

H. Michael

ELECTRONIC LABORATORY
IND Drafting & Routing Lab
EXPERIMENTATION

45

190 ft²

E.B. Bevan

Present
Concentration Space

126 ft²

Lab

Dead end hallway

QUIET STUDY ROOM

44

M. Han

D.R.L. ALTERATIONS

2/7/1973

FUNDS AVAILABLE

N.S.F. GRANT	35000
UNIV. GEN. FUNDS (DOXER)	500
B & G FUNDS (MCALPHER)	500
	<hr/>
TOTAL AVAILABLE	37000

WORK TO BE PERFORMED:

BASIC D.R.L. CONTRACT	28500	(CHK)
ALTERNATE #1 REVISED	2000	
MUSEUM BASEMENT A/C	5000	
CONTINGENCY REQ'D	1500	
	<hr/>	
TOTAL WORK (INCL. CONTINGENCY)	37000	

2200 UNIT
2800 OK.

Henry Kretchmar

1701 Arch Street
Philadelphia, Pa. 19103

GENERAL BUILDING CONTRACTOR

phone: 215-564-0796

FEB 7 1973

PROPOSAL

FEBRUARY 7, 1973

UNIVERSITY OF PENNSYLVANIA
CONSTRUCTION DEPARTMENT

UNIVERSITY OF PENNSYLVANIA
CONSTRUCTION DEPARTMENT
3451 WALNUT STREET
PHILADELPHIA, PA. 19174

ATTENTION: MR. EDWARD S. WALTHERY JR.

RE: Alterations to Rooms B-W8, B-W6 and B-W4
Radiocarbon Laboratory
David Rittenhouse Building
209 S. 33rd Street, Philadelphia, Pa.

Gentlemen:

We propose to furnish labor, materials and equipment to perform all work shown and described on Plans \$6159, #6160 and #6161, dated 1-19-73 and the Specifications for Project #1678, with exceptions as follows;

1. Lighting to consist of 16 2 Tube Fluorescent Fixtures, surface mounted equipped with filters, isolated grounds, separate panel feeders as required to guarantee no electrical interference with the regulated voltage equipment being used in this laboratory.
2. Cooling shall be provided as follows:
 - a. Air Cooled Compressor on roof and Air Handler above ceiling in laboratory B-W8. (5 Ton equipment by Feeders or Equal)
or
 - b. Water cooled 5 ton unit, set on floor of laboratory B-W8 (York or Equal)
3. Air Cooling Units to carry one years service contract

BASE BID: All work as described and noted, except Alternate #1

TWENTY EIGHT THOUSAND FIVE HUNDRED DOLLARS (\$28,500.00)

ALTERNATE #1: All work as described and noted with the following exception;
Present duct to remain and reconnected to existing roof exhaust.
No New Duct. Corridor Duct Insulation to be external wrapped.

Two Thousand Dollars.....(\$2,000.00)

Henry Kretchmar

1701 Arch Street
Philadelphia, Pa. 19103

GENERAL BUILDING CONTRACTOR

phone: 215-564-0796

PROPOSAL

PAGE TWO _____

We agree to be bound by the requirements of Executive Order #11246, as amended
(Equal Employment Opportunity Requirements)

HENRY KRETCHMAR, OWNER



henry kretchmar

1701 Arch Street
Philadelphia, Pa. 19103

GENERAL BUILDING CONTRACTOR

phone: 215-564-0796

PROPOSAL

FEBRUARY 7, 1973

University of Pennsylvania
Construction Department
3451 Walnut Street
Philadelphia, Pa. 19174

ATTENTION: MR. EDWARD S. WALTHERY JR.

RE: MASCA Laboratories, University Museum
33rd & Spruce St.
Philadelphia, Pa.

Gentlemen:

We propose to furnish labor, material and equipment to complete installation of the following cooling systems in Rooms #180-181-182-183-184-185 and 175

- 1-5 Ton Water Cooled Air Condition Unit, mfg by York
- Sheet metal work, Drain and Electric Hook up with
- 1 Year service contract.

For the Sum of FIVE THOUSAND DOLLARS

(\$5,000.00)

Museum -
Sink removal -

HENRY KRETCHMAR, OWNER

Henry Kretchmar

C-14.
Relocation - small detector
Fume hood - wiring
Ond rod
Safety for H₂O - A-C

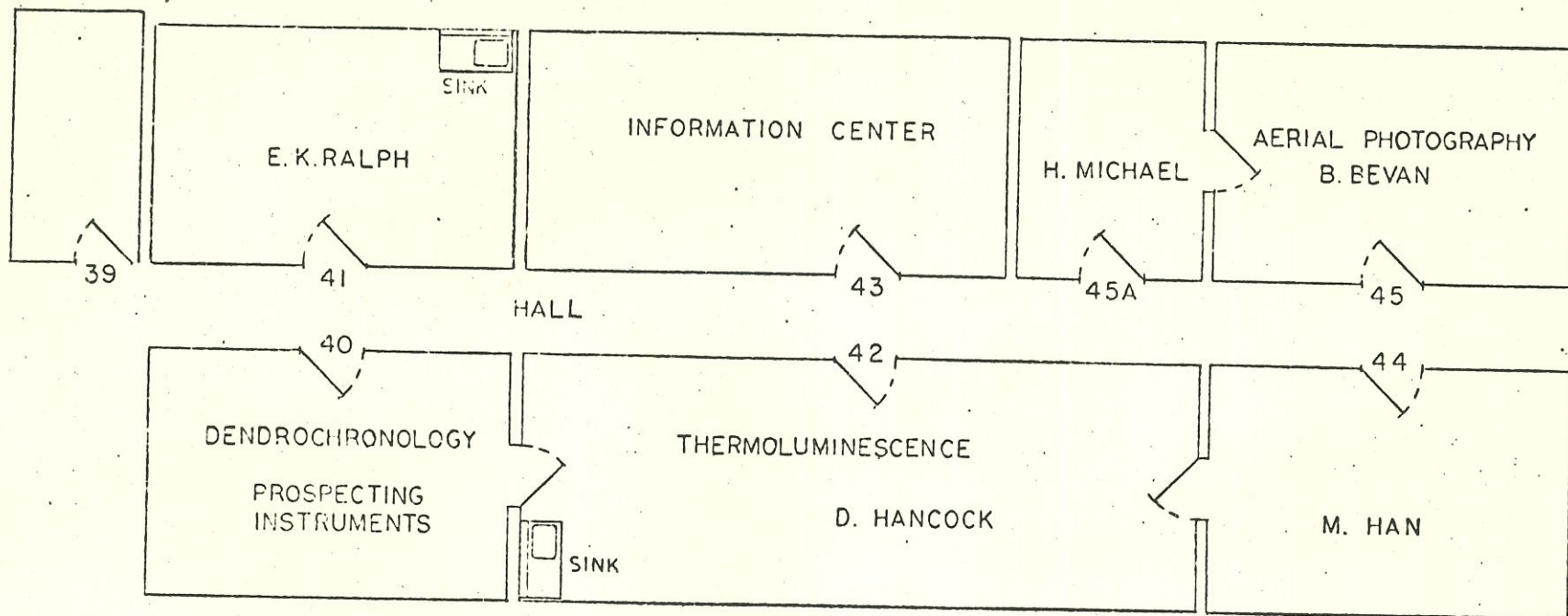
October 24th, 1978

TO: John W. Thomas, Radiation Safety Physicist

FROM: Elizabeth K. Ralph

The ^{14}C source is in room BW8 DRL. It consisted of 3 mcu when purchased on 8/1/69.

Table II. MASCA LABORATORIES, UNIVERSITY MUSEUM



10 ft
SCALE

AD97P

UNIVERSITY of PENNSYLVANIA

PHILADELPHIA 19104

The Faculty of Arts and Sciences

DEPARTMENT OF PHYSICS

February 20, 1980

Prof. Walter D. Wales, Chairman
Department of Physics, DRL/E1

Dear Prof. Wales:

Our radiocarbon laboratory in rooms BW4, BW6, and BW8 is now extremely crowded. We need a storeroom nearby for components that we use only occasionally.

We have stored some things in 1W16, but I understand that this and adjacent rooms are going to be reshuffled.

The most convenient room for our storage would be BW9A. I understand that this room has been assigned to Prof. Mann, but that he may not use it.

We should appreciate it very much if we could have permission to occupy room BW9A.

Sincerely yours,

Beth

Elizabeth K. Ralph

EKR:bh

MASCA Present Space

		Space Per Capita
Eric	302 sq. ft.	302
Wever	270	270
Han	266	266
Ralph	288 minus	
Michael	117	177
Bell & Flamm ^{+ students}	193	< 97
John	20 (1 desk)	20
Instrument Bench, shelves, & drafting	157	26 each for 6 people
Ralph	30 (1 desk)	30

Revised MASCA Space

		Per capita
Eric & Wever	534 sq. ft.	267
Han	266	266
Michael	117	117
Bell & Flamm & students	193	< 97
John	126	126
Instr. Bench, Shelves, & Drafting	157	26 each for 6 people
Ralph	30	30

Needed - one sink for MASCA