'Archaeologists'

Publication/Creation

1911-1913

Persistent URL

https://wellcomecollection.org/works/ageemm2a

Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org

GEBEL MOYA - ARCHAEOLOGISTS

11/13

SALMON AND TROUT FISHING.

GOLF COURSE.

TENNIS.

CROQUET.

CAIRNGORM HOTEL,
AVIEMORE. N. B.

August 22. 1913.

Dear Sir,

In answer to your letter of 18th inst. I am very sorry to say that we never received your letter of July 14. I have been upon the outlook for a young medical man whom I might be able to recommend to you as assistant for your extensive practice but I am very sorry that I have been unable to find one.

Yours truly
Duncan

Harry S. Wellcome Esq

EXETER COLLEGE,

OXFORD.

July 16, 1913

Dear Mr. Williams,

I'm afraid I cannot answer you in the matter of Messrs Adams and Beattie, beyond forwarding your note their names. I have no connexion with your correspondent, you see, such as would warrant me in asking them to apply to you. You can at least of course try & say that their names were suggested by me, if you care to go further with the affair.

As to C.L. Wright, my brother-

in-law, the case is, rather
different, since I might
well be the go-between, if
you think there is a
good chance of you wishing
to marry him. Unless
there is, I hardly think
I should like to worry
him. The facts about
him are perfectly simple;
he's a first rate Engineer
officer with talents of
campaigning (experience, etc.,
who (I believe) would
like to put in some time

with a scientific expedition
while waiting for his next
job. You can judge
whether you want that
sort of man. He would
help to run things splendidly,
I have no doubt: both of
course, on the other hand,
one could order about
a Colonel of Engineers like
one could a boy fresh
from the Universities. If,
then, you think it likely
you would want him, I
should be happy to broach
the matter to him; and

West Wycombe Park Buckinghamshire

Then you could have an interview and find out whether you liked the look of each other. As I said, I don't think my brother-in-law would make any difficulties about terms, if expenses and pocket money were guaranteed. However, there's no reason why you should go further in the matter unless you want to. I was sorry to have to find you with a suggestion made somewhat at haphazard.

Yours sincerely

R. K. Marsden.

54 Hargnore Street

12th July 1913.

Dear Sir,

I desire to thank you for your very kind letter with reference to Mr. Crawford, and also for suggesting the names of Colonel Wright, Messrs. Adams and Beattie. If they will communicate with me I shall be pleased to give their applications careful consideration.

Again thanking you for your kindness,

I am,

Yours very truly,

R.R. Marett Esq.,
Exeter College,
Oxford.

Welbeck Palace Hotel

17th July 1913.

Dear Mr. Marett,

I desire to thank you for your kind letter of the 16th inst. and for the trouble you have taken on my behalf.

With reference to Colonel Wright, as I am requiring the services of an experienced archaeologist for my staff, I am afraid from what you state he would hardly be suitable for that purpose. At the same time, however, I thank you very cordially for mentioning his name to me.

I am,

Yours very truly,

W. P. H.

24 July 1913.

Dear Mr. Marett,

Would you be good enough to send me the addresses of Messrs. Adams and Beattie, and could you let me know if they have had any experience in cave work. I am now looking for a practical, experienced young man, either English, or a Frenchman who can speak English, to join my expedition.

Apologising for troubling you again, and thanking you in anticipation,

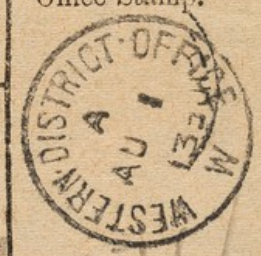
Believe me,

Yours very truly,

POST OFFICE TELEGRAPHS.

If the Receiver of an Inland Telegram doubts its accuracy, he may have it repeated on payment of half the amount originally paid for its transmission, any fraction of 1d. less than ½d. being reckoned as ½d.; and if it be found that there was any inaccuracy, the amount paid for repetition will be refunded. Special conditions are applicable to the repetition of Foreign Telegrams.

Office Stamp.



Handed in at	Office of Origin and Service Instructions	Words	Charges to pay
3.55	Jersey	25	

THIS FORM MUST ACCOMPANY ANY ENQUIRY RESPECTING THIS TELEGRAM.

Received here at

M.

TO

Wellcome

Wigmore St Ldn

Sinel left for London

Cannot Communicate so

he will be Calling Wigmore

St as first instructed

Very sorry J. Sinel

26 July 1913.

Dear Mr. Marett,

Accept my very cordial thanks for your kind letter giving me tha name of Mr. Sinel with whom I have communicated.

Again thanking you,

I am,

Yours very truly,

EXETER COLLEGE,

OXFORD.

26 July, 1913

Dear Mr. Williams,

I know most of the French cave-hunters, and I don't think there is one who can manage English.

We have a young man in Jersey, who is not exactly educated or a gentleman, but has had plenty of cave-experience in our two Jersey Mousterian caves, etc. His name is J. Sinel, Junior, and his address is 12 Royal Crescent, St Helier, Jersey. His father, who is (self-taught) quite a genius at Archaeology & the curator of our museum, and the son is a practical

naturalist' by profession, and
is a great hand at preparing
museum specimens, photo-
graphy, etc, etc. This
fellow is a perfect devil
for finding things: and I
think he could manage all
the organizing of an exca-
vation by himself
(he certainly did it
admirably for us under
his father's eye and
mine); but he is
not a trained archaeologist
and his judgment about
what was found would
not be trustworthy, though

he has the knowledge of the
man who has handled
specimens. You would
do worse than take him.
He's married, however
(I think), and has nothing
but what he makes. But
I daresay £100 and his
expenses might tempt
him — if his father, and our
Museum, can spare him.

I have asked my friend
Dr. Schiller to send you,
if he can, the address
of his late pupil, Adam
Beattie. He has
done work at Arco Arno,
but I don't know whether

caves came out. Beattie
is a rich man and (I
fancy) has financed Adam
brothers. They're both
first-class men, excellent
with boring of all sorts.

Yours very truly
R. R. Marett.

Dr. Expedition
Dr. Egypt.

Come up very soon.

July 2nd: 1913

C. J. S. Thompson Esq:
54 A Wigmore St: W.

Dear Sir -

Dr. Ray - who is I believe writing to you today - recommends me to make application to you respecting the post of archæologist in the Exped.n to the Sudan.

On May 29th. last I applied to Mr. Wellcome but have received no

answer hitherto. Neither have I seen the advertisement which I understand has been issued for the purpose of securing an archæologist.

I venture to ask if it will be necessary for me to repeat my application, stating my qualifications, or is my previous letter still under consideration?

Yours Faithfully

Walter J. Kaye, Jun.

564 Wellcome K-

25 July 1913.

Dear Sir,

Your letter of the 24th inst. duly to hand enclosing a card from Dr. Ray, and I have brought your application before Mr. Wellcome. Unfortunately your letter which you state you forwarded on 29th May must have been lost while Mr. Wellcome was travelling in out-of-the-way places abroad, or it would have received attention. Therefore I should be much obliged if you would kindly repeat your qualifications for the post, giving full particulars of your experience, honorarium required, etc. If you will kindly let me have these as early as possible, I will see that the matter is brought before Mr. Wellcome without delay.

Thanking you in anticipation,

Faithfully yours,

Walter J. Keyo Esq., B.A., F.S.A.,
Pembroke,
Harrogate.

C. J. S. Thompson, Esq:
54 A Wigmore St:
~~Henry S. Wellcome, Esq., F.S.A.,~~
~~Snow Hill Buildings,~~
LONDON, ~~E.C.~~ W.

July 26:
~~May. 29th~~, 1913.

Dear Sir,

I am advised by my friend, Dr. M.B. Ray, of Harrogate, to apply to you with reference to a position as one of your archaeologists in your expedition to the Soudan.

I have had considerable experience in archaeological work, and possess the following qualifications:

B.A. (Dunelm) in literis antiquis.
F.S.A.(London) since 1897.
F.S.A.(Scotland)
Hon. Member:- Spalding Gentlemen's Society (antiquarian, founded 1710)
Member:- Yorkshire Archaeological Society.
Monumental Brass Society, London.
Assoc. des Naturalistes de Nice et des Alpes-Maritimes.

I am an alumnus of the Universities of Durham and Bruxelles, and the following is a list of my works already published, or about to be published:

Roman (and other) Triple Vases.
History of Gosberton, Lincs.
Registers of Newchurch, Lancs.
Grasse (Riviera) and Vicinity.
Heraldic Brasses (in Fox-Davies' Art of Heraldry, published, 7 guineas).
Notes on Aldborough, N.R. Yorkshire.

and have contributed literary matter to various publications, while sketches from my own pencil have appeared in

"The Antiquary", "Daily Mail", and "Daily Graphic".

Among other antiquarian activities, I have excavated Yorkshire barrows and investigated pre-historic sites in the Alpes-

Maritimes, France. I have also taken an interest in pottery.

Having been for some time engaged in scholastic work I am accustomed to control others.

Reference is kindly permitted to:

Rev. Canon J.T. Fowler, D.C.L.,F.S.A., Durham.
F. B. Jevons, Esq., Litt. D., Principal, Bp. Hatfield's Hall, Durham.

and to other distinguished archaeologists.

I am also known to:
Prof.R.A.S. Macalister, M.A.,F.S.A.,
Henry Peet, Esq., M.A.,F.S.A.,J.P.,
Sir John Watney, F.S.A.,
Rev. J. Charles Cox, LL.D.,F.S.A.,

As to the matter of an honorarium,I should be willing to accept £30 a month.

In conclusion, I shall be very pleased to wait upon you at your convenience, in London, when I shall be able to give you further particulars of my qualifications, and I need hardly add that should you honour me with the appointment, I should use every endeavour to merit, by my industry and loyalty, your complete satisfaction.

I beg to remain,

Dear Sir,

Yours faithfully,

Walter J. Kaye, jun:

28 July 1913.

Dear Sir,

I desire to thank you for your kind letter of the 26th inst. enclosing particulars of your archaeological work and experience. I have placed your application before Mr. Wellcome this morning, and should be glad to know when you are likely to be in London, so that I can make an appointment to see you.

Awaiting the favour of your early reply,

I am,

Faithfully yours,

W.J. Kaye Esq.,
Pembroke,
Harrogate.

PEMBROKE
HARROGATE.

July 29: 1913

Dear Sir,

In reply to your kind letter of the 28th. inst:, for which I thank you, I can be in London on Thursday or Friday of this week. If you could kindly arrange for an interview on either day between 3 & 5 pm, I should

men be able to return
the same day.

Thanking you in
anticipation

I beg to remain
Yours faithfully
Walter J. Kaye, Jun.

C. J. S. Thompson, Esq:
54 A Wigmore St:
London W.

Between
10 & 12
on Sunday

30 July 1913.

Dear Sir,

I desire to thank you for your kind letter of the 29th inst., and I regret I shall be away on Tuesday and Friday afternoon this week, but I could see you between 10 and 12 o'clock on Friday morning next. Kindly let me know if this is convenient for you.

Faithfully yours,

W.J. Kaye Esq.,
Pembroke,
Harrogate.

PEMBROKE
HARROGATE

July 31: 1913

Dear Sir,

Please accept my best thanks for your kind letter of 30th. inst: I shall hope to have the pleasure of calling upon you tomorrow (Friday) morning at 10.30; and

trust this time will
suit your convenience.

Yours faithfully
Walter J. Kaye, Jun.

C. J. S. Thompson, Esq:
54 A Wigmore St:
London W.

54a Wigmore St.

28 July 1913.

Dear Sir,

Mr. F.C.S.Schiller has mentioned your name to me in connection with archaeological work. I should be glad to know if you are disengaged for the coming season, and if you are open to join an archaeological expedition to Upper Egypt. If so, I shall be pleased to make an appointment to see you.

I am,

Faithfully yours,

W.J.P. Phythian-Adams Esq.,
Artillery Mansions,
Westminster.

ARTILLERY MANSIONS
S.W.

JULY 29 1913.

Dear Sir,

I am in receipt of your letter of the 28th for which I thank you. I am expecting to spend the winter months in the Sudan with Prof. Garstang and the Meroe Expedition and it is therefore highly improbable that I should be able to join you in Upper Egypt. Perhaps you could tell me the exact time at which you expect to be out there.

My friend, Mr I.H.Beattie, who is engaged with me in Archaeological research, is, however, in a different position from myself with regard to the Meroe Expedition and could very easily join your party instead. I suggest that you should make an appointment with him and talk the matter over. We live together at the above address.

I am,

Yours faithfully,

W.J. Phythian-Adams.

C.J.S.Thompson Esq.,
54a, Wigmore Street,
London, W.

W.P.N.

28 July 1913.

Dear Sir,

I desire to thank you for your kind letter of the 26th inst. with reference to Messrs. Beattie and Phythian-Adams, and for the trouble you have taken on my behalf.

I am,

Yours very truly,

F.C.S. Schiller Esq.,
Corpus Christi College,
Oxford.

26/7/13

Corpus Christi College.
Oxford.

Dear Sir,

Mr R.R. Marett asked me a little time ago whether I knew of any young archaeologist who wd be suited to conduct cave exploration in Nubia & I told him Mr J.H. Beattie & W.J.P. Phythian-Adams might be available, unless they have returned to Asia Minor to excavate Hittite remains. Mr Marett now writes to me that you desire their address & I find which is Artillery Mansions, Westminster, S.W.

I may add that both these gentlemen were distinguished Scholars of this College & are very intelligent & keen. They have also had considerable experience of excavation & Mr Beattie has been in Egypt. When last I

heard of them (last May) they were engaged in writing an account of their Gittisli pottery finds. If you only want the services of one of them, the other wd. probably wish to join the expedition on his own account as Mr Beattie is a man of means. Believe me

Very truly yours

F. C. S. Schiller

(Senior Tutor of C. C. C.)

H. S. Wellcome Esq.

52A Wigmore Street.

11th July 1913.

Dear Sir,

I should be glad if you would kindly let me know if you can recommend me a young practical archaeologist, who has had some experience in work in prehistoric cave dwellings. I require someone to fill a post I have vacant on my staff proceeding to excavate in the Soudan next season.

Apologising for troubling you and thanking you in anticipation,

I am,

Yours very truly,

Professor Boyd Dawkins,
Victoria University,
Manchester.

Batts
Somerset
19.VII.1913

Dear Sir,

Your letter of 11th

July has caught me up, and

I am sorry to say that I do

not know of any one likely

to undertake explorations in

the Soudan. I have also

asked Gray of the Taunton

think, at home. Were I young and free
I would myself be a candidate for so
fascinating a work.

Yours truly

W. Boyd Dawkins

H. S. Welcome Esq
54a Wigmore Street

Museum and some others
with success.
You may fare better by
applying to Prof Ridgeway
of Cambridge, or to my
namesake the head of the
British School at Athens,
both of whom are in touch
with the young lions at
Cambridge. Both are, I

May 29: 1913

Henry S. Wellcome, Esq., F.S.A.,
Snow Hill Buildings,
London, E.C.

Dear Sir,

I am advised by my friend, Dr. M. B. Ray, of Harrogate, to apply to you with reference to a position as one of your archaeologists in your expedition to the Soudan.

I have had considerable experience in archaeological work, and possess the following qualifications:

B. A. (Dunelm) in literis antiquis.
F.S.A. (London)
F.S.A. (Scotland)
Hon. Member - Spalding Gentlemen's Society (antiquarian, founded 1710)
Member - Yorkshire Archaeological Society.
Monumental Brass Society, London.
Assoc. des Naturalistes de Nice et des Alpes-Maritimes.

I am an alumnus of the Universities of Durham and Bruxelles, and the following is a list of my works already published, or about to be published:

Roman (and other) Triple Vases.
History of Gosberton, Lincs.
Registers of Newchurch, Lancs.
Grasse (Riviera) and Vicinity.
Heraldic Brasses (in Fox-Davies' Art of Heraldry, (published, 7 guineas).

and have contributed literary matter to various publications, while sketches from my own pencil have appeared in

The Antiquary, Daily Mail, and Daily Graphic.

Among other antiquarian activities, I have excavated Yorkshire barrows and investigated pre-historic sites in the Alpes-Maritimes, France. I have also taken an interest in pottery.

. Having been for some time engaged in scholastic work I am accustomed to control others.

Reference is kindly permitted to:

Rev. Canon J. T. Fowler, D.C.L., F.S.A., Durham.
F. B. Jevons, Esq., Litt. D., Principal, Bp. Hatfield's Hall, Durham.
Prof. R. A. S. Macalister, M.A., F.S.A.,

and to other distinguished archaeologists.

In conclusion, I shall be very pleased to wait upon you at your convenience, in London, when I shall be able to give you further particulars of my qualifications, and I need hardly add that should you honour me with the appointment, I should use every endeavour to merit, by my industry and loyalty, your complete satisfaction.

I beg to remain,

Dear Sir,

Yours faithfully
Walter J. Kaye, jun.

? age
salary

Duplicate

S.M.

Snow Hill Buildings,
London, E.C.

30th May 1913

Dear Sir,

Your letter of May 29th, addressed to Mr Wellcome, is duly received. Mr Wellcome is abroad at the present time but as soon as he returns to London your letter shall be placed before him.

Yours faithfully,

(Sd) E. Maund
Secretary.

Walter J. Kaye Esq. Jun.,
Pembroke,
Harrogate

PEMBROKE
HARROGATE

Aug: 18: 1913

H. S. Wellcome, Esq: F.S.A.

54A Wigmore St:

London W.

Dear Sir,

In reference to the interview you were kind enough to give me in London a fortnight ago, I now venture to ask whether you have any vacant post

for an assistant archaeologist?
Since I saw you I have
not so far applied
to any of the other
archaeological expeditions
as you advised, as
I should much prefer
if possible to be a
member of your ex-
pedition to the Sudan
and to gain experience
and practice in
your own accurate
scientific methods.

With kind regards
and thanking you
for your courtesy,

I beg to remain
Yours faithfully
Walter J. Kaye, Jun.

20 August 1913.

Dear Sir,

In reply to your kind letter of the 18th inst. I am sorry that I have not a vacancy for an assistant archaeologist for my expedition or I should have been pleased to have considered the matter. As I suggested to you at our interview, I think the best plan would be for you to work up the subject thoroughly well before going out to do field work, as it will be more to your advantage to be well grounded in every branch of the subject before undertaking practical work.

I am,

Yours very truly,

Walter J. Kaye Esq.,
Pembroke,
Harrogate.

Archaeologist

OXFORD UNIVERSITY APPOINTMENTS COMMITTEE.

Office Hours: 9-1 P.M. AND 2-4 P.M.
(SATURDAYS, 9-1 P.M.)
Interviews: 9.30-10.30 A.M. AND 12-1 P.M.
(SATURDAYS, 9.30-11 A.M.)

Postal Address:
THE SECRETARY, APPOINTMENTS COMMITTEE,
OLD CLARENDON BUILDING,
OXFORD.
Telegrams: 'APPOINTMENTS, OXFORD.' CODE A.B.C.
Telephone: OXFORD, 225

C.J.L. Thompson Esq.,
Earley Mews,
Wigmore Street,
London W,.

11th. April 191 3

Dear Sir,

At the end of last year you kindly informed us that you wanted an assistant archaeologist for your Museum.

We sent word to several of our candidates of this post, and I understand that some of them applied to you.

I should be much obliged if you would let me know if the post was filled through our help or not.

Yours truly,

H. Wace Field

Secretary

Easley Mews.

14 April 1913.

Dear Sir,

In reply to your letter of the 11th inst. I am sorry to say that not one of the candidates who applied to me through you to fill the post of assistant archaeologist was suitable. I am, therefore, open to consider further applications. I thank you very cordially for the kind help you have given me.

I may say that in the autumn I shall be requiring the services of a young graduate as an assistant in a scientific library. It would be necesaary for him to have had some experience as a catalogueer and bibliographer. I have not yet written to Mr. Madden, but it is probable that he will know of a suitable man and one perhaps trained by himself. I just mention this in passing in case you may hear of a man who may like to fill this post.

Faithfully yours,

(signed) C J S T.

N. Mansfield Esq.,
Sec. Oxford Appointments Committee.

Archaeologist

University of Cambridge

APPOINTMENTS BOARD

SECRETARY:
H. A. ROBERTS, M.A.
ASSISTANT SECRETARY:
R. S. GOODCHILD, M.A.
ALL COMMUNICATIONS TO BE ADDRESSED TO THE SECRETARY.

UNIVERSITY OFFICES
ST ANDREW'S STREET
CAMBRIDGE
TELEGRAMS: APPOINTMENTS, CAMBRIDGE.
TELEPHONE: No. 627.

November 30th, 1912.

C.J.S.Thompson.Esq.,
The Library,
Easley Mews,
Wigmore Street, W.

Dear Sir,

I have your kind letter of November 29th enquiring for an Archaeologist. I am making enquiries at once and will report to you in the course of a day or two any possible candidate. It would be a great help if you could give me some idea of the stipend. I know of one good man, but he is at present getting £400 a year and of course he would want some kind of permanence, but perhaps you would let me know about this?

Faithfully yours,

H. A. Roberts

Easley Mews (Entrance)

Wigmore Street.

London. W.

The Secretary.

Appointments Board.

University Offices.

St. Andrew's Street. Cambridge.

Dear Sir.

I desire to thank you for your kind letter of 30th Nov., and note that you will endeavour to put me in touch with a suitable man.

I was hoping, if possible, to obtain a young man at a salary of about £150 a year. This will probably give you an idea as to the kind I want.

Thanking you for your kindly interest in the matter.

Faithfully yours.

BRIDGE 30 PM DEC 12

POST CARD

CAMBRIDGE 2.30 3 DEC 1?

½ HALFPENNY ½ POSTAGE

C.W. Thompson Esq
Library
Easby Mews
Wigmore St.
London. W.

CAMBRIDGE UNIVERSITY APPOINTMENTS BOARD.

3.12.12.

University Offices,
61, *St Andrew's Street, Cambridge*

Thanks for yours.
I will write & say
I am looking for a
young man in accordance
with your suggestion

H. A. Roberts Esq.

University of Cambridge

APPOINTMENTS BOARD

SECRETARY:
H. A. ROBERTS, M.A.
ASSISTANT SECRETARY:
R. S. GOODCHILD, M.A.
ALL COMMUNICATIONS TO
BE ADDRESSED TO
THE SECRETARY.

UNIVERSITY OFFICES
ST ANDREW'S STREET
CAMBRIDGE
TELEGRAMS: APPOINTMENTS, CAMBRIDGE.
TELEPHONE: No. 627.

December 19th, 1912.

C.J.S.Thompson.Esq.,
Library,
Easley Mews,
Wigmore Street, W.

Dear Sir,

I am extremely sorry to say that after many enquiries we are unable to find a young Arachaeologist with the necessary knowledge available. We very much regret not being of any assistance to you, but trust that we may have the opportunity of making any suggestions at any future date.

Faithfully yours,

H.A. Roberts

THE BRITISH SCHOOL OF ARCHAEOLOGY IN EGYPT.

1912.

The first half of the season's work of the British School of Archaeology in Egypt has been full of interest in its results. An extensive cemetery was found, only 35 miles south of Cairo, which dates from the earliest historic age down to the Pyramid period, during the five dynasties O to IV. About 600 burials, spread over a mile of desert, have been recorded, and a great number more had anciently been destroyed. This cemetery (known as Tarkhan, from the name of the nearest village) will be one of the standard sources for our knowledge of the early historic civilization. It is the most northerly settlement known of so early an age, and its discovery thus extends the view of that period which has already been gained by Professor FLINDERS PETRIE's work in the Royal Tombs of the early dynasties and Temple of Abydos. The precise period was ascertained by a tomb with pottery of a pre-Menite king, and another very large tomb with pottery of Narmer-Mena. The presence of so large a cemetery, for the most part before the age of Mena, shows that there must have been a chief town of this period in the region of the present Kafr Ammar. This town preceded the founding of Memphis, and appears to have been begun a few generations earlier than the reign of Mena. It was thus probably started as the northern capital of the dynastic race before Memphis, and gradually fell out of use under the early Pyramid kings. This site consequently shows a stage in the conquest of the land by the kings of Abydos. Some few tombs of the VIth, XIth, and XIIth dynasties are also found, and then the place seems to have been deserted till the XXIIIrd dynasty.

The special feature of the cemetery is the extraordinary preservation of both woodwork and clothing. The earliest linen is firm and fresh, and some large sheets of the XIth dynasty were as white and sweet as if they had just come from the loom. The wooden coffins are, many of them, quite strong and sound, built up of planks of acacia or shittim wood. Sometimes the beams and poles of the tomb-roof were still in place, just as originally built.

Although the Egyptian houses of that early age have all perished in the cultivated plain, yet some precious pieces of house timber were found re-used in the construction of the coffins. These pieces agree with Professor PETRIE's explanation of the panelled or recessed decoration in buildings, as copied from timber houses, built of overlapping vertical planks. The planks have rows of tie-holes cut in the edges for lashing them together, so that they could slide one over the other when shrinking or swelling. Some examples were deeply weathered outside and burnt inside, showing that a house had been burnt down and the scraps used as waste for coffin-building. We have thus preserved to us the examples of those wooden forms which were so generally copied in the early architectural decoration.

Coffins made of basket-work, reeds or withies, were also found. One in specially complete condition had the small leaf-buds of the withies showing; it was a hamper of large size, and was carried up by hand to the Cairo Museum to ensure its perfect preservation. Other basket-work and matting

get Photo &c

of various kinds were also found and have been safely removed. Wooden trays, both for domestic use and of large size for biers, were discovered in firm condition. The bed frames were varied in form and often perfectly preserved; sometimes they even retained the rush-work webbing or decorative plaiting of palm fibre. The poles were beautifully tapered and jointed, usually with carved bulls' legs to support them. There were five or six different patterns of jointing for the corners of the frames. No such furniture has been found in the Royal Tombs, or any other cemeteries of this age.

Of less perishable work a great quantity of pottery was found, and some 300 alabaster vases and dishes, mostly perfect. On one bowl was the oldest figure known of the god Ptah. Copper tools were also occasionally found, although nearly all the tombs had been ransacked anciently for valuables. Pottery jars in one tomb had excellent drawings of the fore part and hind part of a zebra. In another tomb were impressions of four sealings of King Narmer-Mena, which are not hitherto known to us. One gives his full name as Nar-mer-za, another is of the seal of his palm plantation, another of his flower-garden (?), and the fourth is the great seal of the Fayum, with the shrine and sacred crocodile and rows of crocodiles on the curly waves of the lake. A large tank-shaped spoon of ivory is carved with rows of animals on each side of it; another ivory spoon has a wavy serpent handle. That the sacred beetle was then venerated is shown by a reliquary carved in the form of a beetle, with the lid kept in place by the string for suspension. Among the objects of later times there were some which proved of interest, and in a Roman burial a large gold ring was found and a necklace of gold beads of plaited pattern.

The work here was carried on by the students of the School, Messrs. MACKAY, WAINWRIGHT, and ENGELBACH, and Mr. ELVERSON, working with Professor FLINDERS PETRIE. Mrs. PETRIE made the drawings, and during part of the time Mr. LAWRENCE, from Carchemish, helped in the excavations.

The second half of the season's work was devoted to the great city sites: Memphis, where the School has worked during four years already, and Heliopolis—the ancient On—where no British work had hitherto been done. The need of working down six feet or more under water obliges these sites to be taken when the water level is low, late in the season.

At Memphis, which was in charge of Mr. MACKAY, a gigantic sphinx of alabaster has been found, lying between the two well-known colossi. This is the largest sphinx that has ever been transported, being twenty-six feet long and fourteen feet high, and weighing about eighty tons. Happily, it has never been defaced, and except for some slight natural fissures the face is as perfect as when carved. It does not bear any name, but belongs either to the XVIIIth dynasty or the best work of the XIXth dynasty, about 1300 B.C. It was thrown over on its side anciently, but it will be set up again this summer, and will remain one of the sights of Memphis like the great Colossus.

Further north, at the north gate of the temple of Ptah, another sphinx has been found, carved in red granite, over eleven feet long and seven feet high, inscribed by Rameses II. The head had been exposed for a long time and is defaced, but the body and base are perfect. Near this was a fine group in red granite, representing Rameses II and the god Ptah standing. Here the faces are quite perfect, and only a small amount of weathering has occurred on the lower parts. The scale is life size, with large crowns of feathers on the heads, and the work is of the best class of the period. As the whole weighs about nine tons, it will be sent direct to the Ny Carlsberg Museum, Copenhagen, as it is Denmark and

not England that provides for the excavation of Memphis; some day museums in England may have spirit for such work. A large figure of a scribe, covered with inscription, but headless, was also found near this group. At the same place, the north gate, deep down, lay a lintel of Amenemhat III, showing that he had built this gateway. This is specially interesting, as Herodotos ascribes the north gate to Moeris, the Greek name of this king. Thus it is seen that Herodotos had correct information about the builders, as he also correctly attributed the western portico and colossi to Rameses.

At Heliopolis, Prof. Flinders Petrie and Mr. Engelbach were searching the history of the site preparatory to heavy work in future, The most obvious feature is that the city had been deserted ever since the Persian invasion in 525 B.C. The top surface is dated by the pottery to the sixth century B.C., and there is scarcely a trace of the Ptolemaic, Roman, or Arab ages. The reason for this appears to be that Heliopolis was the key to Memphis, barring the road of an eastern invader. Hence it was for the Persian a mere obstacle, to be destroyed so as not to hinder future access to Memphis.

The temple enclosure was three-quarters of a mile long, It was surrounded by two great walls each forty to fifty feet thick, which have been traced on all sides and planned. This wall was built in the XIXth dynasty. In the north-west corner was a fort, also of massive brickwork; but this could not be traced far owing to the obstruction of a cemetery and cultivation. The great surprise, however, was finding an earthen fortress of the same type as that at Tell el Yehudiyeh, which Prof. Petrie discovered in 1906 and attributed to the Hyksos. This fort at Heliopolis is of the same form, a rounded square, the same size across (quarter of a mile), and has the same thickness of wall—over a hundred feet. It likewise has no gateway in the axis, the walls or bank, where it is opposite to the obelisk, being still twelve feet above the base of the obelisk.

The obstruction of cultivation prevents the search for the sloping gangway over the wall which is seen at Yehudiyeh. By a large block of temple sculpture found under the wall, it must be later than the Old Kingdom; and the XIXth dynasty walls run upon the sides of the square fort. Its age must then be between the VIth and XVIIIth dynasties; and as no Egyptian would have made such an earthwork the date is brought to the Hyksos age, or the earlier barbaric invasion. It seems probable that the Hyksos had established their headquarters in the damaged buildings of the XIIth dynasty temple, and thrown up an earth *zaribeh* round it after their wont.

A field close to the well-known obelisk was hired, and dug over down to the native sand. The main result was finding many pieces of another obelisk here, erected by Thothmes III, and re-inscribed by Rameses II. The eastern gateway of the whole temple was also found; and fragments of inscriptions of ten different kings. Atogether the first attempt to trace the history of Heliopolis has proved of much interest, and further work will be most desirable.

The whole of the results will be published this year in two volumes. The two annual volumes are given to all subscribers of two guineas and upward. Cheques may be made payable to H. Petrie and crossed Child & Co. Address, Hon. Secretary, British School in Egypt, University College, Gower Street, London, W.C.

BRITISH SCHOOL OF ARCHAEOLOGY IN EGYPT
AND EGYPTIAN RESEARCH ACCOUNT.

PATRONS—VISCOUNT KITCHENER OF KHARTUM, G.C.B., O.M., G.C.S.I., &c., &c.
THE EARL OF CROMER, O.M., G.C.B., G.C.M.G., K.C.S.I., &c., &c.

GENERAL COMMITTEE (**Executive Members*).

LORD AVEBURY, D.C.L., F.R.S., &c.,
Past President of the Society of Antiquaries.
WALTER BAILY.
HENRY BALFOUR, Pitt Rivers Museum, Oxford.
FREIHERR von BISSING, University, Munich.
Dr. T. G. BONNEY, LL.D., F.R.S., F.S.A.,
Prof. R. C. BOSANQUET, University of Liverpool.
Rt. Hon. JAMES BRYCE, D.C.L.
Prof. J. B. BURY, LL.D., Litt.D.,
King's College, Cambridge.
*SOMERS CLARKE, F.S.A.
EDWARD CLODD.
Prof. BOYD DAWKINS, F.R.S.,
The Owens' College, Manchester.
Prof. Sir S. DILL, Litt.D., Queen's College, Belfast.
*Miss ECKENSTEIN.
Dr. GREGORY FOSTER,
Provost of University College, London.
Dr. J. G. FRAZER, University of Cambridge.
ALAN GARDINER. University of Manchester.
*Prof. ERNEST GARDNER, University College, London.
Prof. PERCY GARDNER, Litt.D., F.B.A., F.S.A.,
Lincoln College, Oxford.
Rt. Hon. Sir GEORGE T. GOLDIE, K.C.M.G.,
President of the Royal Geographical Society.
Prof. GOWLAND, F.R.S., V.P.S.A.,
Mrs. J. R. GREEN.
Mrs. F. LL. GRIFFITH.
Dr. A. C. HADDON, F.R.S.,
Lecturer in Ethnology, Cambridge.
JESSE HAWORTH.
Dr. A. C. HEADLAM, Principal of King's Coll., London.
*Sir ROBERT HENSLEY (*Chairman*).
D. G. HOGARTH, M.A., F.B.A.
Sir HENRY H. HOWORTH, K.C.I.E., F.R.S.
Baron A. von HÜGEL,
Ethnological Museum, Cambridge.
Prof. MACALISTER, F.R.S., F.S.A.,
St. John's College, Cambridge.
Dr. R. W. MACAN, Master of University College, Oxford.
Prof. MAHAFFY, D.D., D.C.L., &c.,
Trinity College, Dublin.
*J. G. MILNE, M.A.
Sir COLIN SCOTT MONCRIEFF, K.C.M.G.
ROBERT MOND, M.A., F.R.S.Ed., F.C.S.
Prof. MONTAGUE, University College, London
WALTER MORRISON.
*Miss M. A. MURRAY.
Prof. P. E. NEWBERRY, University of Liverpool.
F. W. PERCIVAL, F.S.A.
Dr. PINCHES. University College, London.
Dr. G. W. PROTHERO, Litt.D., LL.D., F.B.A.,
Past President of the Royal Historical Society.
Dr. G. A. REISNER.
Sir WILLIAM RICHMOND, R.A.
Prof. F. W. RIDGEWAY, F.B.A.,
Gonville and Caius College, Cambridge.
Mrs. STRONG, LL.D.
Mrs. TIRARD.
E. TOWRY WHYTE, M.A., F.S.A.

HONORARY TREASURER—*H. SEFTON-JONES.

HONORARY DIRECTOR.

Prof. FLINDERS PETRIE, D.C.L., F.R.S., F.B.A., &c.

HONORARY SECRETARIES.

Mrs. H. F. PETRIE, } University College, Gower Street,
*Dr. J. H. WALKER, } London, W.C.

LOCAL HON. SECRETARIES.

E. C. R. Armstrong, Cyprus, Eglinton Road, Dublin.
Prof. Baldwin Brown, 50, George Square, Edinburgh.
Miss J. M. Buchanan, 13, Buckingham Terrace, Hillhead, Glasgow.
J. Read Burton, Vine Grove, Brondesbury Park, N.W.
Dr. Jean Capart, Musées Royaux, Brussels, Belgium.
J. S. Dismorr, F.R.G.S., Arden, Sheepcote Road, Harrow.
Rev. J. G. Duncan, Manse, Kirkmichael, Banffshire, N.B.
Mrs. Eustace, Arundel.
Miss R. Fry, Failand House, Failand, Bristol.
F. W. Green, 5, Wordsworth Grove, Cambridge.
Miss C. Herford, The University, Manchester.
S. E. Loxton, Fern Dell, Cannock.
C. J. Marshall, Balvaird, Cheam, Surrey.
Rev. Canon MacInnes, 35, Sharia Falaki, Cairo.
Rev. Canon Rawnsley, Crosthwaite Vicarage, Keswick.
Seymour de Ricci. Avenue Henri Martin 36, Paris.
Mrs. Arthur Rowntree, Bootham School, York.
Mrs. Thompson, Eversley, Haling Park Road, Croydon.
Miss A. Urlin, 109, Elm Park Mansions, S.W.

First Copy.
Late one made.
File with Archaeologists.

Discovery of Remains of Primitive Ethiopian Races in Southern Sudan.

By Henry S. Wellcome.

Abstract.

During an expedition to the Sudan in 1900 I made some discoveries of neolithic objects, fragments of primitive pottery at Senaar. Time did not permit then of further investigations. In 1910 I returned to Senaar and commenced the excavation of the site in Gebel Moya, but experienced the greatest difficulties, nor only on account of hindrance placed in my way by the native Omdeh of the district, but also because of the lack of discipline and training of the only men available for the labour involved. These difficulties, however, were gradually overcome, and by degrees the men employed were trained and organised. On exploration I found many inteesting caves and also a large ba basin within the upper hills.

In the first year of excavation trial pits were sunk at various places, and later on a series of trenches were begun. The objects excavated consisted of stone implements of various forms such as axes, adzes, chisels, planes and hammers. Pottery was found in immense quantities, for the most part in fragments it is both plain and ornamented, and shows a very large number of types and shapes and decoration. The discovery of large numbers of implements and pigments used in the manufacture of pottery in various places indicated the existence of potteries. Fragments of walls and floors of buildings, frequently decorative, were also found. Clay figurines of human and animal form occurred in large

numbers, and were of various types.

A certain number of dateable objects were also found, consisting, for the greater part, of scarabs and plaques, in some cases bearing cartouches. In no case does any of these dateable objects indicate a date later than the Ptolemaic period.

Beads, amulets, and other ornaments were also found, made both of coarser stone and of finer materials. A vast number of lip and ear ornaments also occurred, and traces of workshops were found for their manufacture.

During the second season excavations were caried out with an increased staff, and with the addition of highly trained excavators who had worked with Dr. Reisner. Whereas in the first season graves were only occasionally found, and for the most part in or near habitation s, the work of the second season was devoted largely to the excavation of the cemeteries which had been discovered. Many ornaments and other objects, such as the lip and ear studs, were found with the human remains <u>in situ</u>. Besides the human interments, there were also found animal burials, including those of cows.

All inferences and conclusions in regard to the discoveries will be reserved until it has been ascertained that the whole of the available evidence has ben determined.

Discovery of Remains of Primitive Ethiopian Races in Southern Sudan.

By Henry S. Wellcome.

Abstract.

During an expedition to the Sudan in 1900 I made some discoveries of neolithic objects, fragments of primitive pottery at Senaar. Time did not permit then of further investigations. In 1910 I returned to Senaar and commenced the excavation of the site in Gebel Moya, but experienced the greatest difficulties, nor only on account of hindrance placed in my way by the native Omdeh of the district, but also because of the lack of discipline and training of the only men available for the labour involved. These difficulties, however, were gradually overcome, and by degrees the men employed were trained and organised. On exploration I found many inteesting caves and also a large ba basin within the upper hills.

In the first year of excavation trial pits weresunk at various places, and later on a series of trenches were begun. The objects excavated consisted of stone implements of various forms such as axes, adzes, chisels, planes and hammers. Pottery was found in immense quantities, for the most part in fragments it is both plain and ornamented, and shows a very large number of types and shapes and decoration. The discovery of large numbers of implements and pigments used in the manufacture of pottery in various places indicated the existence of potteries. Fragments of walls and floors of buildings, frequently decorative, were also found. Clay figurines of human and animal form occurred in large

numbers, and were of various types.

A certain number of dateable objects were also found, consisting, for the greater part, of scarabs and plaques, in some cases bearing cartouches. In no case does any of these dateable objects indicate a date later than the Ptolemaic period.

Beads, amulets, and other ornaments were also found, made both of coarser stone and of finer materials. A vast number of lip and ear ornaments also occurred, and traces of workshops were found for their manufacture.

During the second season excavations were caried out with an increased staff, and with the addition of highly trained excavators who had worked with Dr. Reisner. Whereas in the first season graves were only occasionally found, and for the most part in or near habitation s, the work of the second season was devoted largely to the excavation of the cemeteries which had been discovered. Many ornaments and other objects, such as the lip and ear studs, were found with the human remains in situ. Besides the human interments, there were also found animal burials, including those of cows.

All inferences and conclusions in regard to the discoveries will be reserved until it has been ascertained that the whole of the available evidence has ben determined.

archaeologist

W.P.H.

24 July 1913.

Dear Sir,

I am desirous of meeting with a young man with some practical experience in cave work to join my expedition to the Sudan in the coming season. If you know of any such, or one with good archaeological experience with some knowledge of anthropometry, I should much appreciate your kindness if you would put me in touch with the same.

Apologising for troubling you,

Believe me,

Very truly yours,

Professor Sollas,
Queen's College,
Oxford.

Easly Mews.

29th. November, '12.

Dear Sir,

I shall be glad if you will kindly let me know if you can recommend either a lady or a gentleman with some knowledge and experience of archaeological work, for the purpose of assisting in the classification and sorting of the objects excavated by Mr. Wilcome at Gebel Moya. You will no doubt remember seeing the result of the two years' excavations which I had here at Wigmore Street a few month ago, and we now wish to procure some further assistance in classifying and arranging them. The work would have to be carried on in London and would doubtless occupy some considerable time.

Awaiting the favour of your reply,

I am,

Faithfully yours

C.J.S.T.

Professor Myres,
New College,
Oxford.

101, BANBURY ROAD,
OXFORD.

Dec. 12th, 1912.

Dear Sir,

I ought to have replied earlier to your letter of November 29th., asking me to recommend someone with archaeological experience. Hitherto I have not succeeded in finding anybody who would serve your purpose, but if I hear of anyone in the course of the Vacation, I will write again without delay.

Yours very sincerely,

John L. Myres.

c/o Miss Johnson
46 Campden House Court
W.

Mr. Angelo Hayter.

4. Forest Rise.
Walthamstow. N.E.

A. A. K Hayter Esq.

4 Forest Rise

Walthamstow NE

64, Wigmore Street,

31st. October, 1912.

Dear Sir,

Professor Flinders Petrie, whom I saw this afternoon, has kindly given me your name, as I wish to meet with someone who has some knowledge of Egyptian archæology, especially ancient pottery and early stone implements, for the purpose of classifying and arranging the same. The work would last for some time, and it is necessary that it should be carried out in London.

I should be glad if you would kindly let me know at your early convenience if your services would be available and the remuneration you will require for the same.

On hearing from you I will arrange a personal interview, when we can discuss further details.

Thanking you in anticipation,

Faithfully yours,

C.J.S.T.

H.A.K. Hayter, Esq.,
4, Forrest Drive,
Walthamstow, N.E.

Home address:
4 Forest Rise,
Walthamstow N.E.
now at Wroxeter, Salop.
Sunday. 3 Nov.r 1912.

Dear Sir, In reply to your enquiry of 31st ult. I should be quite ready to undertake such a task as you mention.
You will probably have heard from Prof. Flinders Petrie that I have specialised in Egyptian Archaeology and in fact am proud of being one of his pupils.
But you will easily understand that I cannot decide offhand or propose terms of remuneration without

hearing further details –
eg: size of the collection & so on.
With regard to a personal
interview, I am busy on a
Roman site here for several
days more, after which I am
due at Hereford for similar
work (to last a week).
Can you wait till then for us
to discuss details? The
long journey to and from
London in the midst of my
work here is what I wish
to avoid, if possible.

I am Sir

Yr. Faithfully

A.G.K. Hayter

Easley Mews,

5th. November, 1912.

Dear Sir,

I desire to thank you for your letter of the 3rd. inst.

I understood from Prof. Petrie that you would be engaged for a short time longer on the excavations at Wroxeter. If you could call and see me in London in a fortnight's time that would answer the purpose and will save you a special journey.

I should be glad to know, at your early convenience, the approximate date on which you could come and will arrange to see you between 10 and 12 o'clock on the morning you may fix.

Faithfully yours

C.J.S.T.

A.G.K. Hayter, Esq.,

Wroxeter, Salop.

4 Forest Rise

Nov: 22nd Walthamstow

Dear Sir,

My husband has asked me to write to you to explain that he was too much occupied to come & see you the week end he was in town, as he had hoped ~~to~~ would have been possible.

His work at Wroxeter is now over, but he is busy working

On another site near Hereford.
He quite expects he will be in
London after the 29th & could
see you early in December.
If however a preliminary visit
from me would forward matters.
I could call on you any after-
noon after Tuesday Nov: 27th I may
add that I have always studied
Egyptology with my husband &
was out with him in Professor
Flinders Petries' camp.

My address till Tuesday morning
Nov: 27th is City Arms Hotel
Hereford.

Afterwards Rat on my letter.

Yours faithfully
Mary L. Hayter

C. F. S. Thompson Esq:
Wigmore St:

Easley Mews

25th November 1910.

Dear Madam,

I desire to thank you for your letter of the 22nd inst., and note that Mr. Hayter hopes to be in London after the 29th, and will be able to come and see me after that date. I could perhaps give you some particulars, and also you could give me some details of your work if you would be good enough to call here and see me on Thursday morning any time convenient to you between 10 and 12 o'clock.

Thanking you for your suggestion,

I am,

Faithfully yours,

C.J.S.T.

Mrs. Hayter,
4 Forest Rise,
Walthamstow.

4 Forest Rise,
Walthamstow N.E.

Saturday. 15 Decr, 1912.

Dear Sir,

I am sorry I have been prevented from calling on you at an earlier date. I propose to call on you on Monday morning between 10 & 12 o'clock in hopes of finding you in - to discuss the possibility of my arranging Mr. Wellcome's pottery.

I am, Sir,

Yrs faithfully

Alg. K. Hayter.

54, Wigmore Street,
W.

23rd. October, 1912.

Dear Sir,

I desire to thank you for your kind letter of the 19th. inst.,

I am sorry that Mr. Appleton, whom you mention, was unable to join Mr. Wellcome's Expedition, so should you hear of anyone else likely, I should be glad if you would kindly let me know.

Thanking you very cordially on Mr. Wellcome's behalf for the trouble you have taken in the matter,

I am,

Faithfully yours,

C.J.S.T.

Professor W.L.H. Duckworth,

Jesus College,

Cambridge.

9 Manley Road
Waterloo
Liverpool.

August 22nd. 1912.

Dear Mr. Wellcome,

Many thanks for your letter. As I have been unable to offer you terms which you could accept it would hardly be fair for me to expect you to pay any of my expenses when I came up to town to examine the pottery.

I remain,
Yours very truly,

T. Eric Peet

54 Wigmore Street

21st August 1912.

Dear Mr Peet,

Your favour of the 16th inst. is duly to hand. Of course you know best what your time is worth to you, but I do not feel justified in paying the amount you mention. This work has no commercial features, and yields me nothing; it is necessary to keep within moderate limits, and to adhere to budgets or the work could not go on. Even with economy, the expense of carrying out the excavations in this far away region are very great.

If you will kindly send me a note of your railway fare to and from London to view the objects, I will remit you the amou

I remain,

Yours very truly,

Henry S. Wellcome.

per

9 Manley Road,

Waterloo,

Aug.16th. 1912. Liverpool

Dear Mr. Wellcome

It is always a very difficult thing for an archaeologist to fix the value of his services as there is no standard. One might perhaps be guided by the remuneration made by the Cairo Museum to those engaged on its catalogue, which is at the rate of £400 a year or rather more than £7-10-0 per week. But the misfortune is that while this would be a very fair arrangement if I were to work in Liverpool it would barely cover my expenses in London. Naturally, although it would be a great pleasure to me to work over your material it would hardly be possible for me to give up two or three weeks of my time, which happens to be particularly full up just at present, on these terms. I therefore suggest a weekly salary of £7-10-0 and in addition my expenses at the rate of a pound a day, out of which I should of course be expected to pay all my travelling expenses. I fear you will think this a very extravagant estimate, but I have tried simply to reckon what my time is worth to me; no smaller sum would justify me in setting aside my own work. In any case if you think it too much you have only to say so. Of course in the event of your needing my help in the actual publishing of the pottery, for example in the writing of descriptions, or the arrangement of plates, or the correcting of proofs, in short in any work I can do at home, it would always be entirely freely at your service. I should consider that naturally as part of our agreement.

Yours very truly,

T. Eric Peet

S.H.B.

12th August 1912.

Dear Mr. Peet,

I have received your of the 10th inst. There will be no difficulty about leaving the arrangement of time open so that it will suit your convenience.

We can discuss the question of illustrations and groupings when you are in town.

I fancy that you will find that it will take you more than a fortnight to go thoroughly over the material.

Would you kindly write and let me know what renumeration you would expect for the work. Perhaps you will indicate this at so much per week.

Yours very truly,

H.S.W.

8 Annesley Road

Seacombe

Aug. 10th. 1912. Cheshire.

Dear Mr. Wellcome,

I have been thinking over the pottery which I saw at your warehouses on Thursday with a view to forming some idea of the amount of time needed to work through it satisfactorily. I have come to the conclusion that it would take me about a fortnight to do what is necessary. This would include going over the whole and personally handling every sherd, dividing it into classes in order to form a basis for later work on the site, and arranging what vases and what sherds would need photographing in view of your eventual publication. If you wished me to undertake the preparation of the report for this end I should have sufficient notes to do this and should of course work it up here afterwards from my notes, coming up to London once or twice more in order to verify points on the spot and correct errors.

I was very much interested by what I saw and it would indeed be a very great pleasure to work through such a fine series of pottery. There are some most remarkable Mediterranean parallels and, though they may be quite fortuitous, one is tempted to believe that there may be something more in it, especially as we are nowadays in the habit of looking towards Africa for light on these early Mediterranean things.

Time is the great difficulty with me. I could almost certainly get a week in September perhaps even a fortnight . I can be absolutely certain of getting the work done before the end of November or even earlier if necessary. But it would be a great convenience if you could leave me rather open to put in the time when it best suitd me. From what I saw I should think it would be a good plan to have

about twenty photographic groups of sherds made on perhaps whole plates, together with some twelve or more photos of complete vases and several line drawings of restored shapes, with possibly one or two three-colour photos of the painted sherds. These are merely suggestions and would be of course entirely subject to your own wishes on the point. I was judging rather on the analogy of the Malta excavations where we had a very similar mass of pottery to deal with.

We are just leaving the above address and the new will be 9 Manley Road, Waterloo, Liverpool, where we shall always be from tomorrow onward.

Yours very truly,

T Eric Peet

8 Annesley Rd
Seacombe
Cheshire

4. VIII. 12.

Dear Sir

I shall be very pleased to come up to London on Thursday & will be at Wigmore St. about 2.45 in the afternoon.

Yours very truly
T Eric Peet

H S Wellcome Esq

54 Wigmore St.

2nd August 1912.

Dear Sir,

Professor Newberry has kindly informed me that you are willing to come to London to see me in connection with some pottery and other objects excavated during my recent expedition to the Sudan.

If convenient to you, I shall be pleased to see you at the above address any afternoon next week, if you will kindly let me know a day or two in advance.

I am,

Yours very truly,

H.S.W.

Eric Peet Esq.,
8 Annesley Road,
Seacombe, Cheshire.

TELEPHONE, 37 ALLERTON.
THE GRANGE,
ST MICHAELS HAMLET,
LIVERPOOL.

31 July 1912

Yrs ~~Sincerely~~
S & W Yard

Dear Mr Wellcome,

I saw Eric Peet this morning & he says that he will have time, & that he will be delighted to see your Nubian 'finds' of pottery. Where would you like him to go up to town? Would you kindly write to him & fix a time? His address is 8 Annesley Road

Seacombe
Cheshire.

I was deeply interested and all that-

You showed me last week and hope that you will let me have another opportunity to see your collections

I will write again later about the Brit. Assoc. Meeting at Dundee

Yours truly

Percy E. Newberry

July 14th 1912.

Dear Mr. Wellcome.

I think I ought to definitely decline your very kind offer that I should go with you to the Sondan this winter. My work for the Survey Dept. (the Publications) and the installation of the Aswan Museum ought to be done first. I shall not go to Egypt quite so soon as I expected as my eyes are bad & I want to get them quite well this summer. I should have liked to go with you very much as it is always more interesting to work at the sources of things

Yours very sincerely
Amsworth

Knowle
Ashburton
Devonshire

University College,
London.

Aug 23. 1912.

Dear Mr Wellcome,

I regret I shall not be able to join your archaeological staff. I have not yet heard definitely about my other post. but still I feel that I ought not to keep you waiting about. Please accept my sincere thanks for keeping the post open to me, as you have done. I greatly value your courtesy in the matter.

Yours very truly,

Ernest Mackay.

54 Wigmore St.,

1st August 1912.

Dear Mr. Mackay,

With reference to your application to join my archaeological staff, I hope to be able to see you again on the matter in the course of a week or two.

I am

Yours very truly,

H. S. W.

UNIVERSITY OF LONDON,

UNIVERSITY COLLEGE.

TELEPHONE NO.
3979 CENTRAL.

GOWER STREET, LONDON, W.C.

July 17. 1912.

Dear Sir/

I have pleasure in enclosing the further particulars for which you asked me this afternoon.
I was educated at the Bristol Grammar School, and left at the age of nearly sixteen, as my father did not believe that a long school education was necessary to success in business life.
I was then articled to a photographer for three years, 1895-8, in order to obtain as much experience as possible to assist in my father's business, that of a Christmas card manufacturer & Fine Art publisher.
From 1898-1903 I was in business with my father, who at the end of that time withdrew, leaving the business to the partner whom he had taken during the time I was articled.
Shortly after, my father fell seriously ill and wanted ~~him~~ allow no one but myself to look after him. In my spare

time during this period I attended lectures at University College, Bristol (now the University of Bristol) by Professor Ernest Sibree, M.A., on the Egyptian & Assyrian languages.
On the death of my father in 1906, I was taken on probation by Professor Flinders Petrie and engaged as his chief assistant the following year. Since then I have been given sole charge of work for the British School of Archaeology in different parts of Egypt.
I have matriculated at Bristol University & can obtain the degree of Bachelor of Arts (by research) in two years' time.

Yours faithfully

Ernest Mackay.

L. J. S. Thompson Esq.

17th July 1912.

Mr. Ernest Mackay, address, University College, Gower Street, W.C., until the end of August.

Native of Bristol, age 32, single.

Education, studied hieroglyphics for five years under Professor Sibiree, M.A., University, Bristol.

Has been engaged for six years with Prof. Flinders Petrie, as chief assistant during excavations, and for the last two years has been in sole charge of excavation work at Memphis, where he had sole control of from four to five hundred men, with whom he came in personal contact, paying wages, etc.

His excavations include:-

Gizeh. I. dynasty.
Refa, VI, XII. dynasties, and Coptic.
Athribis, Roman period.
Goehna, XI, XVII, and XVIII dynasties.
Medum, III to IV dynasties.
Kafr Amar, Pre-dynastic, I, III to XI dynasties.

Accustomed to indexing and recording, and has a knowledge of all details of archaeological work.

Is expert in repairing pottery implements, etc., and also in modelling copies, has done all Professor Petrie's work for some years.

Is a good photographer, and a good hand in making plans and surveying.

Last excavation at Luxor.

Prehistoric work. Has excavated together with Prof. Petrie, large prehistoric and proto-dynastic cemetery at Kafr Ammar.

Is the author of the following publications:-

"Meydum, and Memphis III."
"The Labyrinth, Gerzeh and Mazghuneh."
"Memphis V., Heliopolis and Kafr Ammar."

Physical health good, and well acclimatised to Egypt. Has never suffered from malaria.

References. Prof. Flinders Petrie.
Dr. J. Herbert Walker,
55 Fitzroy Road, Regents Park, N.W.
Dr. Derry.
Many others may be had on application.

Salary required per annum, Three hundred pounds, all expenses and messing being found while away on expedition. For a shorter period than a year, Fifty pounds per month, exclusive of travelling expenses and living.

In conversation, Mr. Mackay said that he had heard of Mr. Wellcome's work in the Sudan while he was in Cairo, but did not say from whom. He said that Dr. Derry had mentioned it, but had been very close, and mentioned nothing.

His only reason for leaving Prof. Petrie was that he wanted to have a wider experience. He had never been south of Luxor, and would greatly like to take part in work in the Sudan.

He is now engaged to be married.

16th July 1912.

Dear Sir,

With reference to your letter of June 12th, offering your services in connection with archaeological work, Mr. Wellcome has now returned to London, and has requested me to communicate with you on the subject. I should be glad if you would kindly call here to-morrow afternoon between 2 and 3 o'clock, and I shall be pleased to confer with you on the matter.

I am,

Faithfully yours,

Ernest Mackay Esq.,
University College,
Gower Street.

UNIVERSITY OF LONDON,

UNIVERSITY COLLEGE.

TELEPHONE NO.
3979 CENTRAL.

GOWER STREET, LONDON, W.C.

16th July 1912

Dear Mr Smith,

This will introduce to you Mr. E. Mackay for many years associated with Professor Flinders Petrie in Egypt and well known in the Archaeological world He would like to go to the Sudan with Mr. Wellcome so I am sending him in the first instance to you so that you may arrange an

interview with Mr Wellcome.

Yours very truly.

Douglas E. Derry.

---

with Prof Petrie until end of Aug

---

6 years Experience in Egypt

Would like to go to Sudan

Prehistoric Research

University College,
Gower Street,
London.

June 29. 1912.

Dear Sir/.

I answered an advertisement of yours, in the "Times" of June 15th ult., but as I was a week late in doing this I thought perhaps you did not receive my letter.
I am well acquainted with all branches of prehistoric research in Egypt, and only this year have been helping Prof. Flinders Petrie to excavate a portion of a large prehistoric and Proto-dynastic cemetary at Kafr Ammar, Upper Egypt.
I have worked for Prof. Petrie as his chief assistant for the last six years, during the last three of which I have conducted investigations for him in a seperate camp in which I had sole charge of the work. This includes excavations at our site at Memphis.
As well as predynastic work my esperience has included all periods, but I am especially well informed and most interested in the earliest periods of Egyptian history.
I have contributed chapters to the following publications of the British School of Archaeology: — "Meydum and Memphis III", "The Labyrinth, Gerzeh & Mazghuneh" (in press), and am at present writing a portion of a book on the last seasons work.

If necessary, I am capable of managing up to four hundred men single handed, and have always been very successful in directing difficult work.
Prof. Petrie will be most willing to answer any questions as to my capabilities and power of conducting original research, should you write to him at University College.
My age is thirty two next month, and I should require a salary of £400 per annum, or £300 with all expenses paid.

Yours faithfully,

Ernest Mackay.

P. S.
If desired I can give you references as to my ability to several well known people in Egypt who are engaged in archaeology.

(archaeologist)

University College
Gower Street
London

June 29th 1912.

Dear Sir.

I have just seen your advertisement for an archaeologist in the "Athenaeum" of today and beg to offer you my services.

I have spent the last six years in various parts of Egypt excavating for the British School of Archaeology, and have worked on cemeteries, of all periods from Predynastic down to Coptic.

My experience has included independent work with large gangs of men, both in the desert and at Memphis. My records of this work are included in the following publications of the British School of Archaeology; — "Meydum, & Memphis III", "The Labyrinth, Gerzeh and Mazghuneh" (in press), and "Memphis V, Heliopolis and Kafr Ammar" (now being written).

I am a first rate photographer and well accustomed to planning, & simple surveying.

I enclose copies of testimonials from Prof. Flinders Petrie, F.R.S. and Dr. Walker, M.A., Lecturer on the Egyptian Language, University College, London. The following have expressed their willingness to answer any questions on my behalf: —

G. Quibell Esq., Inspector-General of Antiquities, Egypt.

Dr. Derry, University College, Gower Street, London, W.C.
My age is 32, and the salary I should require would be £400 per annum, or £300 with all expenses paid.

Yours faithfully

Ernest Mackay.

COPY.

55, Fitzroy Road,

Regent's Park, N.W.

June 11th, 1912.

I have known Mr. Ernest Mackay intimately for the last six years and have formed the highest opinion of his character. I can most honestly recommend him for any post of trust requiring a straightforward tactful man.

His organising ability and general administrative capacity are most marked. For the six years which I have known him he has worked for the "British School of Archaeology in Egypt and Egyptian Research Account" and he has always given us of his best work whole-heartedly and without stint.

My very best wishes for his success accompany this testimonial.

(Signed) (Dr.) J. HERBERT WALKER, M.A. Oxon.

COPY.

I CERTIFY that Mr. Ernest Mackay has been engaged with me for the past six years. He has good tact in managing up to 400 men and boys, and is firm but is liked by workmen. He has a strict sense of business, is punctilious in accounts and writing detailed reports. He is leaving his present occupation solely because desiring some higher post. I fully respect his personal character.

(Signed) W. M. FLINDERS PETRIE,

Professor of Egyptology,
University College, London.

10th June, 1912.

Archaeologist

S. H B

13th June, 1912

Dear Sir,

Your letter of the 12th inst. addressed to Mr. Wellcome is duly received.

Mr. Wellcome is still abroad, but on his return to London your letter shall be brought before him.

Yours faithfully,

E. M

Secty.

Mr. Ernest Mackay,
University College,
Gower Street, W.C.

University College
Gower Street
London.

June 12th. 1912

Dear Sir/.

I hear that you are conducting important excavations in the Sudan + should like to offer you my services. I have worked for Prof. Flinders Petrie as chief assistant for the past six years, and have conducted independent excavations for him during the last three years of that time. I am very anxious to do some archaeological research in the Sudan, partly for the fact that you are likely to obtain important results, + partly for the sake of experience in that country. I hold excellent testimonials from Prof. Petrie + others, but should you wish to avail yourself of my services, Prof. Petrie would be willing to write to you direct concerning my capabilities.

For further references I beg to mention the name of Dr. Derry of University College, London. + Mr Quibell, Government Inspector of Antiquities in Egypt.

Yours very truly,
Ernest Mackay.

COPY.

55, Fitzroy Road,

Regent's Park, N.W.

June 11th, 1912.

I have known Mr. Ernest Mackay intimately for the last six years and have formed the highest opinion of his character. I can most honestly recommend him for any post of trust requiring a straightforward tactful man.

His organising ability and general administrative capacity are most marked. For the six years which I have known him he has worked for the "British School of Archaeology in Egypt and Egyptian Research Account" and he has always given us of his best work whole-heartedly and without stint.

My very best wishes for his success accompany this testimonial.

(Signed) (Dr.) J. HERBERT WALKER, M.A. Oxon.

COPY.

I CERTIFY that Mr. Ernest Mackay has been engaged with me for the past six years. He has good tact in managing up to 400 men and boys, and is firm but is liked by workmen. He has a strict sense of business, is punctilious in accounts and writing detailed reports. He is leaving his present occupation solely because desiring some higher post. I fully respect his personal character.

(Signed) W. M. FLINDERS PETRIE,

Professor of Egyptology,
University College, London.

10th June, 1912.

Archaeologist.

72. Abbey Road.
S. John's Wood.
London. N. W.

14. 8. 12

Dear Sir Wellcome,

I am sorry to note your decision, because I confess your expedition is the sort of thing I would be keen on working with.

But of course I quite appreciate the fact that I was handicapped beyond being able to claim any extensive field experience: personally I am confident of my ability to master the situation (otherwise I would not have applied). I say this because I would not like you to think I filed my application without due consideration. I know how annoying it is to wade through a lot of impossible applicants and I much appreciate the attention you have given to my papers.

As regards your suggestion of work in other directions I am there anytime you have any use for me and shall always be happy

to have the pleasure of working for you

Yours faithfully

Noël Peaches

Easley Mews without LIB.

14th August 1912.

Dear Mr. Heaton,

I have carefully considered the points discussed in our conversation, and I have arrived at the conclusion that your actual field experience is not sufficient for the purposes of any position I could offer you in connection with my forthcoming expedition.

However I think it quite probable that there may be from time to time materials in connection with my work which your special qualifications and experience might enable you to deal with. In such cases I should be very pleased to consider you in this connection.

As on reflection I found I could form sufficient opinion from the information you gave me, I have not written to the gentleman you mentioned.

I remain,

Yours very truly,

H.S.W.

N.B.—This Form must accompany any inquiry respecting this Telegram.

POST OFFICE TELEGRAPHS.

EYRE & SPOTTISWOODE, Ltd., London

If the Receiver of an Inland Telegram doubts its accuracy, he may have it repeated on payment of half the amount originally paid for its transmission, any fraction of 1d. less than ½d. being reckoned as ½d.; and if it be found that there was any inaccuracy, the amount paid for repetition will be refunded. Special conditions are applicable to the repetition of Foreign Telegrams.

Office of Origin and Service Instructions.

Charges to pay s. d.

Abbey Rd *Handed in at* 1337 P.M. *Received here at* 1338 P.M.

TO { Wellcome 54 Wigmore St.

Will call 5 oclock as arranged

Heaton

9th August -

SEE NOTICE AT BACK.

A.

Prefix_____ Code_____

POST OFFICE TELEGRAPHS.

(Inland Telegrams.)

No. of Telegram_____

For Postage Stamps.

To be affixed by the Sender.

Any Stamp for which there is not room here should be affixed at the back of this form.

Office of Origin and Service Instructions.

Copy.

Words.

Charge.

Sent

At 11-30 M.

To_____

By_____

A Receipt for the Charges on this Telegram can be obtained, price one Penny.

When a reply is to be prepaid, write the words "Reply Paid" in the space below. These words are not charged for.

Reply Paid

TO { Revd Healon, 42 Abbey Road, St. Johns Wood -

Please	see	me	Wellcome	to-day
at	5-4	Wiquire	Sheet	5-
o'clock.				

12 words, including the words in the address, 6D. Every additional word, ½D.

FROM {

The Name and Address of the Sender, **IF NOT TO BE TELEGRAPHED**, should be written in the Space provided at the Back of the Form.

(This Paper Manufactured and Printed by McCORQUODALE & CO. Limited.) Wt. 22944/2234. 1-3/12. 15,000,000. Sch. 2.

NOTICE TO THE SENDER OF THIS TELEGRAM.

This Telegram will be accepted for Transmission subject to the Telegraph Acts and Regulations made thereunder, and to the following Conditions:—

1. The charge for transmission will cover the cost of delivery from the usual Delivery Office:—

(*a*) If the address is within three miles from the usual Delivery Office, or within the limits of the Town Postal delivery of that Office (when it is a Head Post Office) if that delivery extends to more than three miles.

(*b*) If the Sender desires it to be forwarded by Post from the Terminal Telegraph Office and shall write the word "Post" before the Addressee's name, and at the end of the address the name of the Office at which the Telegram is to be posted.

2. The charge for delivery of this Telegram during ordinary office hours at any address beyond the limits of free delivery will be at the rate of 3d. for each mile, reckoned from the limits of free delivery. Provided that any fraction of a mile beyond any complete number of miles shall be reckoned as a mile. This charge will be payable by the Sender and should be prepaid.

3. If the Sender desires this Telegram to be forwarded by Train from the Terminal Telegraph Office, he must write the word "Train" at the end of the address, and must pay the actual cost of the conveyance, if such cost be known, or must deposit 1s.

4. The Sender may prepay a reply not exceeding in length 48 words. In such case a Form of Pass will be handed to the Addressee. The Pass will, within two months from its date, frank any Telegram not exceeding in length the number of words stated on such Pass. If the Pass be not used, its value will be paid to the Sender of the original Telegram on application being made, within two months, to the Secretary, General Post Office, London, Dublin, or Edinburgh, as the case may be. The Pass must accompany the application.

5. A Telegram can be repeated back from Office to Office throughout the course of transmission if the Sender desires to adopt this security against the risk of error. The charge for repetition (which must be paid when the Telegram is handed in) is one-half the charge for transmission, any fraction of a 1d. less than ½d. being reckoned as ½d. If containing mercantile quotations or code words a Telegram ought always to be repeated.

6. The Postmaster-General will not be liable for any loss or damage which may be incurred or sustained by reason or on account of any mistake or default in the transmission or delivery of a Telegram.

7. All applications respecting this Telegram must be made within three months from the date of its transmission.

Name and Address of Sender. (FOR REFERENCE ONLY.) H. S. Wellcome 54 Wigmore St. W.

27 New Cavendish St.,

Cavendish Square, W.

1st August 1912.

Dear Sir,

With reference to our interview of yesterday, I have reported the purport of it to my friend Mr. Wellcome, the leader of the archaeological expedition to the Soudan, and he hopes to write to you making an appointment to see you in London next week if possible.

Faithfully yours,

C. J. S. T.

Noel Heaton Esq.,

72 Abbey Road,

St. John's Wood,

N.W.

72. Abbey Road.
S. John's Wood.
London. N. W.

July 31st 1912.

C.J.Thompson Esqr,
New Cavendish Str.

Dear Sir,

With reference to my call of this afternoon, I find that my letter with enclosure, confirming the appointment which failed to reach you was duly posted. I have instituted enquiries as to its fate and would be much obliged if you would do so also as the reprint enclosed was one of the only two copies I had left. Meanwhile I am enclosing my other copy and also copies of one or two other recent publications because I think these will perhaps enable you to judge better if my qualifications will suit your purpose than a mere recital.

An article on decorative painting in prehistoric times, the first of a course of Cantor Lectures, will appear in the Journal of the Royal Society of Arts on Friday next (August 2nd).

Frankly, I am confident I could do valuable work for the proposed expedition, as I have a combination of practical and scientific knowledge which is somewhat exceptional, whilst for my own part I will admit that the opportunity of working in Egypt is one that I have sought for many years and I am prepared to sacrifice my other engagements for it.

I would ask, however, in this connection, in the event of my being appointed, that the matter may be decided pretty soon, as I have already a

72. Abbey Road.
S. John's Wood.
London. N. W.

number of engagements which I should have to cancel, and various literary and professional affairs which I should have to arrange before leaving, whilst I am receiving every day just now enquiries as to lectures for the winter.

I think I mentioned I have already accepted to lecture at Rugby School on the Minoan civilisation of Crete on October 10th and I would not like to cancel this if it could be avoided.

I regret that I omitted to give you this afternoon any references in substantiation of my statements : I therefore append the addresses of a few friends familiar with my work to whom you could refer should you wish :-

Sir Arthur Evans, Youlbury, Nr Oxford, (I ~~have~~ would a testimonial should he be abroad and difficult to reach)

C.T.C.Doll, 5, Southampton Str, Bloomsbury , W.C. (Architect to Sir A.Evans)

Dr T.G.Pinches, Sippara ~~House~~, 10, Oxford Rd, Kilburn, N.W. (Professor of Assyriology, University College, London)

W.H.St John Hope, Clare , Suffolk, (Late Secretary to Society of Antiquaries).

I know a good many of the leading archaeologists and am well known at such places as the Hellenic Society, etc.

Yours faithfully,

Noël Heaton

I am registering this to take no further chances of miscarriage

After College studied Chem under Ramsay
+ Analytical Chemist
Chêque & Colour workers
Stained glass — Chem & Physics

1908 + Kuoxux — Analysis
Silicates

1910 Went to Cuba

Germans — Spec of Colours

NOEL HEATON B.Sc., F.C.S.

Age 34, married.

Graduated at University College, London where he took degree of B.Sc., specialising in Chemistry, Geology and Natural Sciences.

Began as a research chemist, and took up Archaeology from a technical and a scientific stand-point, making analyses of earths, clays, pigments, etc.

Joined Sir Arthur Evans' Expedition to Crete in 1910, and was with him during the season as scientific expert. He examined all fragments excavated, made analyses, and reported upon them as to composition, from which he is enabled, he states, to fix dates with considerable accuracy.

He also made analyses of building materials discovered, and the decorations of the palaces which enabled important data to be fixed.

He is a scientist by training, and has a knowledge of the practical side of making pottery.

As an archaeologist he has studied prehistoric objects including pottery, and especially clays and materials used for decoration.

Has a good practical knowledge of geology, and has had experience, he states, in field work.

Is an expert photographer and accustomed to prepare plans and drawings, and is also experienced in recording and in the command and handling of men.

Salary asked, £200 for six months with travelling expenses paid, and living found.

Write Dr. Fincher - (Assyriology)!
Oxford Road Maida Vale

C. T. C. Dall 5-Southampton St
architect Bloomsbury

C/O MRS, ADAMS,
27 NEW CAVENDISH STREET,
CAVENDISH SQUARE. W.

29th July 1912.

Dear Sir,

With reference to your letter of the 24th inst. in reply to my advertisement re Archaeologist, I shall be glad if you will kindly call and see me at the above address on Wednesday afternoon next, the 31st inst., at three o'clock, when I can discuss the matter with you.

I am,

Faithfully yours,

C.J.S.T.

Noel Caten Esq.,
72 Abbey Road,
St. John's Wood, N.W.

REPLY SENT.
29 JUL 1912

72, Abbey Road,
S. John's Wood,
London. N. W.
July 24 th 1912.

Dear Sir,

Replying to your advertisement in the Times of Monday I beg to offer my services.

I have a thorough knowledge of the methods of results of prehistoric research having been in touch with the leading archaeologists for some years and having worked with Sir Arthur Evans in Crete.

I am a scientist by training and have a wide practical and theoretical knowledge of the many technical problems surrounding such investigations, and am in an exceptional position for interpreting the evidence afforded by the use of various materials etc. As an example of recent work in this direction I may quote :-

Minoan Lime Plaster & Fresco Painting - Journal of R.I.B.A.. October 1911.
I am an expert photographer, have sufficient knowledge of surveying to prepare plans and drawings etc and am accustomed to recording, handling of men and similar incidentals.

As regards salary it is difficult to state a definite figure on the information given, but my ideas are very moderate. I would suggest, not to trouble you with lengthy details at this stage, that if my application is of any interest you might favour me with an interview when I could inform you more fully as to my career.

I am,

Yours faithfully,

Noël Skeaten

Selected Testimonials.

Youlbury,

Nr. Oxford,

December 1911.

Mr Noel Heaton has been out with me at Knossos in order to work at the Minoan frescoes and to examine the processes employed.

His researches on the spot were of a most acute and thorough going character and the result throws a new light on the methods of ancient wall-painting.

He has approached the subject from a broad point of view and he seems to me to combine the widest comparative outlook with the microscopic equipment of a specialist in this branch.

(signed) Arthur J. Evans.

72. Abbey Road.
S. John's Wood.
London. N. W.

30. 7. 12

Dear Sir,

I beg to acknowledge receipt of your letter of 29th and will duly call at the time appointed

Yours faithfully

Noel Heaton

E. J. S. Thompson Esq
Cannock

P.S. I am enclosing a cutting of the publication referred to in my last letter.

Extract from the JOURNAL OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, Third Series, Vol. XVIII. No. 19

MINOAN LIME PLASTER AND FRESCO PAINTING

By NOËL HEATON

LONDON
9, CONDUIT STREET, REGENT STREET, W.
1911

Mount Juktas, from Candia.

MINOAN LIME-PLASTER AND FRESCO PAINTING.

By Noel Heaton, B.Sc., F.C.S.

THE discoveries of painted plaster at Mycenæ have for many years drawn attention to the fact that the technique of painting on plaster employed in Roman and mediæval times was based on a tradition derived from remote antiquity, but it was not until the excavations in Crete, instigated and largely controlled by Sir Arthur Evans, resulted in the discovery of the Minoan civilisation, extending back almost to Neolithic times, that sufficient evidence became available to enable one to formulate any hypothesis as to the origin and course of development of this art.*

Last year, under the direction of Sir Arthur Evans, I made a careful examination of the most important sites, and followed up the evidence thus gleaned, by a detailed and exhaustive study of numerous fragments which I collected for the purpose, and of which I have preserved full data as to place and age.

Putting together the evidence thus obtained, the conclusion that one arrives at, expressed in general terms, is that the now well-known decorative paintings of the Palace of Knossos and elsewhere were executed in a manner closely akin to the buon fresco of the Italians, and that they represent the culmination of a long-continued development of the use of lime plaster; moreover, it is evident that the use of this material as the basis of a decorative process by the Minoans was subsequent to and derived from its development as a means of protection to their buildings from the weather.

The first crude beginnings of the use of lime plaster may be traced back in this district almost to Neolithic times, but it is practically impossible to form an idea as to the date of its first employment, owing to the confusion caused by the disturbance of early buildings by later work on the same site. But by the middle of the Early Minoan period we have ample evidence that lime plaster, of a comparatively crude type, was employed as a protective coating to the rubble masonry of which the buildings were constructed. At Knossos, very little work of this date remains; it was mostly cleared away in the construction of the first great palace in the Middle Minoan period. But I have found here and there fragments remaining on the walls of the earlier buildings, the foundations of which still exist outside the area covered by the

* In addition to the great Palace of Knossos, near Candia, excavated by Sir Arthur Evans, 1900-1910, many other sites have been examined in different parts of the island during the past ten years; the most important of these are the Palaces of Phæstos and Hagia Triadha, near the south coast, excavated by the Italian Mission; the ritual cave in Mount Dicte, excavated by Dr. Hogarth; the Early Minoan settlements at Vasiliki, the Late Minoan town at Gournia, the Late Minoan seaport at Palaikastro, and other sites to the east of the island.

main palace, and large quantities of small fragments are found broken up and used as rubble, embedded in the walls of the later buildings, and more particularly rammed into the floors.

At Vasiliki, however, several buildings of the Early Minoan period remain undisturbed by later alterations, and are preserved in excellent condition. Here abundant remains of plaster are found which may be taken as typical of the period.

Fig. 1 shows a section cut through a representative specimen of this plaster from Vasiliki. It will be seen that the plaster is over 5 cm. in thickness and that it was evidently put on in two coats, for there is a well-marked line of cleavage about 15 mm. from the surface—it is dirty yellow in colour and very hard and tenacious, affording an excellent protective finish to the friable sun-dried brick or loose rubble of which the buildings were constructed.

The composition of this plaster, considering its hardness, tenacity, and freedom from cracks, is rather remarkable. It contains only about 40 per cent. of carbonate of lime, the remainder being mainly silica and alumina;* it is difficult to reconstruct the exact mixture used in its preparation, but the large proportion of alumina and the fact that the silica contained (to the extent of nearly 40 per cent.) is not in the nature of sand, but is in a state of combination, points to the fact that the plaster was prepared by mixing lime with a clay of the type known to mineralogists as zeolite (consisting of hydrous aluminium silicate), the hardness being due not so much to the carbonation of the lime as to the subsequent combination between the two materials with the formation of silicates of lime and alumina.

FIG. 1.—SECTION OF EARLY MINOAN PLASTER FROM VASILIKI.
(Exact size of original.)

The plaster was further strengthened by the addition of an aggregate consisting of small pebbles, fragments of pottery, &c., and a considerable proportion of chopped straw was also added, which was destroyed by the caustic lime, leaving well-defined cavities by which its presence can be identified, and in some cases even casts in carbonate of lime. This type of plaster is quite characteristic of the Early Minoan period, and although detailed examination of many of the fragments from Knossos, referred to above, in no case yields *absolutely* parallel results, the agreement is sufficiently close to warrant the assertion that a plaster of quite similar type was utilised there in the Early Minoan period.

As we pass from the Early to the Middle Minoan period the character of the plaster changes, more and more lime being used. Examination of a number of typical specimens

* For purposes of reference I give the complete analysis of the typical specimen illustrated:—

Soluble in hydrochloric acid (61·57 per cent.)	Calcium oxide (lime)	24·20
	Magnesium oxide	2·24
	Carbon dioxide	16·80
	Iron and alumina	17·23
	Sulphuric anhydride	0·37
	Soluble silica	0·03
Insoluble in hydrochloric acid (38·43 per cent.)	Insoluble silica	37·29
	Alumina, etc.	1·14

from the earlier palace of Knossos shows that the normal plaster used at this period was much lighter in colour, and, whilst firm and sound, is not so hard or tenacious—it is far more characteristic of ordinary lime plaster in fact. It consists on the average of 70 per cent. of carbonate of lime, the remainder being mainly clay with an admixture of fine pebbles and grit. The composition varies in different parts and the plaster is often traversed by streaks of varying colour indicating that the materials were not very well mixed—straw has disappeared from the mixture, and the plaster is altogether closer in texture.

This tendency to increase the content of lime becomes more and more pronounced as we pass through the Middle Minoan period, and the plaster at the end of the period (M.M. 3) is noticeably different from that of the earlier part (M.M. 1 and 2). By the time we reach the middle of the Late Minoan period, when the art and civilisation of the Minoans was at its zenith and the great remodelling of the Palace of Knossos was undertaken, we find that the craftsmen have come to the conclusion that the power of setting to form a plaster was mainly due to the material they obtained by burning limestone, and so used this material pure, without any admixture. By so doing they lose that hardness and tenacity which is obtained by the combination of the lime with the alumina silicates, but they obtain a perfectly homogeneous plaster of a brilliant white colour. The circumstances influencing the change are not far to seek; so long as the chief function of the plaster was structural—the facing of walls to resist decay—colour and texture were immaterial; but as the practice of painting on the walls developed, more and more attention would be paid to producing a surface suitable for decorative treatment. For this purpose fineness of grain, in order to prepare a perfectly smooth surface for painting, and brilliant whiteness in order to enable the designs to tell to the utmost, were desirable, and what the Minoan craftsmen were evidently striving after as their skill in decoration increased.

FIG. 2.—SECTION OF TYPICAL PLASTER OF THE "PALACE PERIOD" AT KNOSSOS (LM_2). (Exact size of original.)

In fig. 2 we have a section cut through a typical specimen of the Late Minoan plaster, together with the backing on which it was in some cases prepared. The difference in *colour* is not of course evident although the photograph gives some idea of the brilliant whiteness of this later material. Comparing it with fig. 1 the great difference in character and texture is evident.

The composition of this plaster, as deduced from the analysis of a large number of representative examples, approximates to that of a pure chalk lime, the content of carbonate of lime varying from 90 to 94 per cent.* In a preliminary account of this plaster,† I discussed at

* Here again it may be of use to give the exact composition of the specimen illustrated:—

Soluble (98 per cent.)	Calcium oxide	51·93
	Magnesium oxide	1·03
	Carbon dioxide	41·18
	Sulphuric anhydride	0·54
	Iron and alumina	1·81
	Alkali &c.	1·39
Insoluble (2 per cent.)	Silica	2·12

† *Journal of the Royal Society of Arts*, January 7, 1910.

length the question as to how it was prepared, and the general conclusion arrived at, from the evidence afforded by its chemical composition and its physical structure, was that nothing was employed in its production but caustic lime, unless some of the original limestone from which the lime was prepared was mixed with it in the form of powder before slaking. This view is further confirmed by the fact that a mile or so from Knossos, up the valley of the Kessoberos, is a huge cavern [fig. 3] in the hillside which marks the site of a Minoan quarry. Analysis of the limestone found in this quarry makes it clear that it was from here that the lime for the plaster was obtained, for the composition is too closely similar to the Late Minoan stucco to be accidental,* and the possibility that such a close agreement with a natural limestone should be reached by any mixture of materials is remote. It is certain that this limestone was quarried for some purpose, and we are justified in assuming that, in seeking for a material which would give them a whiter plaster than they had hitherto used, the craftsmen of the Palace period found that this limestone on burning gave them what they sought, and therefore used it exclusively.

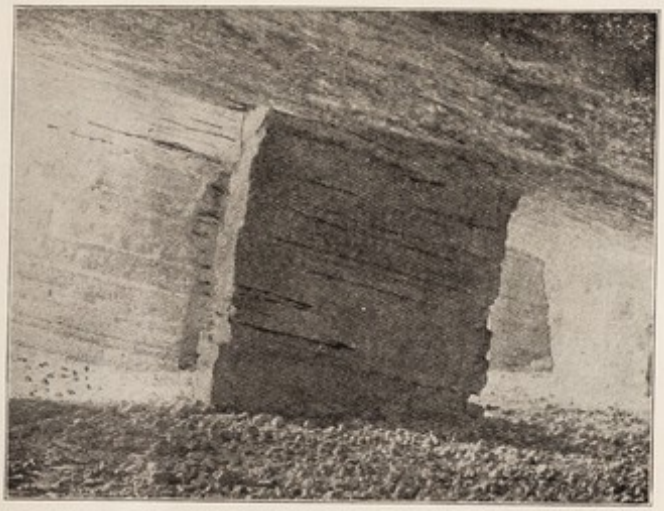


FIG. 3.—ENTRANCE TO LIMESTONE QUARRY.

Exactly how they set about the preparation of such a magnificent plaster from this lime is a matter of conjecture—the traditions of their craft have perished with them. One may suggest, although there is no direct evidence whatever in support of it, that possibly their method of procedure was to keep the lime in a slaked condition for long periods,† and for use mix it with a proportion of the same limestone from which the lime was prepared, this not being burnt but merely reduced to a very fine powder.

USE OF THE LIME PLASTER IN BUILDING.

It will be clear from this brief survey of the nature and development of the plaster that its original use was constructional, and although in later times it becomes chiefly important as a material for decoration, it remained to the end of the Minoan era an essential feature of their architecture, as is evident when we consider the extent of its use in the later Palace of Knossos.

* The close similarity of composition may be seen by comparing the following analysis of a typical specimen with that of the Late Minoan plaster given above:—

Calcium oxide	52·09
Magnesium oxide	trace
Carbon dioxide	41·00
Sulphuric anhydride	0·20
Iron and alumina	2·18
Alkali &c.	0·98
Moisture	1·33
Silica	2·22

† It is conceivable that some of the curious shallow pits found in the floors of the galleries at Knossos may at one time have been used for preserving the slaked lime in good condition.

We must bear in mind that in Minoan architecture we find three principal types of construction, namely:—

1. Rubble and timber construction [fig. 4], used in earlier times and in the internal and partition walls in later times.

2. Gypsum masonry, as in fig. 5. The use of this is characteristic of Minoan buildings—it is a stone composed entirely of large crystals of calcium sulphate, which is found plentifully around Knossos.

3. Limestone masonry, as in fig. 6.

FIG. 4.—RUBBLE WALL (HAGIA TRIADHA).

The method of applying plaster to rubble walls, which obviously need such protection, is seen clearly in fig. 7: the wall, composed of irregular blocks of stone set in a matrix of clay, was first provided with a liberal coat of coarse plaster made of lime mixed with a large proportion of small pebbles and broken pottery. On this backing a first coat of fine plaster was applied in order to form a true surface, which was followed by a second and final coat of uniform thickness if the wall was to be decorated. The section in fig. 2 shows the whole structure, the total thickness of plaster being in this case about three-quarters of an inch. In some cases thin partition walls are found [fig. 8] composed simply of clay, supported and held together by the plaster, which forms a continuous casing over the whole surface.

FIG. 5.—WALL OF SQUARED GYPSUM: THE ROYAL VILLA, KNOSSOS.

In the case of ashlar walls, which did not require to be brought to a true surface, the rough backing to the plaster was omitted, the plaster itself being laid direct on the stone. Gypsum walls are particularly well adapted for receiving the plaster, as a good grip is afforded owing to the exceptional structure of the stone, which consists entirely of large interlocking crystals with serrated edges. Where, as is sometimes the case, gypsum masonry was employed in conjunction with rubble walls, shaped blocks being used for the doorways, &c., the wall would be brought flush with the surface of the gypsum by means of the rough backing

and the fine plaster carried from one to the other, as seen in the diagram [fig. 9]. When one bears in mind the nature of gypsum it is evident that the facing of plaster was even more of a structural necessity than in the case of rubble walls. When protected by this plaster it forms a fairly satisfactory building stone on account of the ease with which it can be worked; without such protection it is unsuitable for any purpose but ornament, for it is so soft as to be readily scratched by the finger nail, and so soluble in water as to almost melt away when exposed to the rain. In a country like Egypt such a stone might perhaps be left unprotected, but in Crete a squared block of this stone will show appreciable denudation after a single season's exposure.

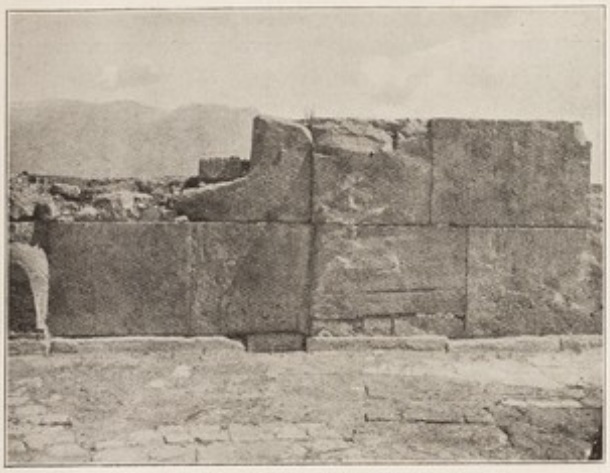


FIG. 6.—LIMESTONE MASONRY: CENTRAL COURT, PHAESTOS.

As a general rule the plaster as applied to gypsum walls is about half an inch thick, but in some cases, notably in the staircase of the Royal Villa discovered some little distance to the N.E. of the Palace of Knossos, it is the merest wash, about one-sixteenth of an inch.*

FIG. 7.—WALL OF THE THIRTEENTH MAGAZINE, KNOSSOS, SHOWING THE METHOD OF FINISHING RUBBLE WALLS WITH PLASTER.

Where limestone was employed in building the plaster facing was not so necessary. The Minoan builders, however, either did not realise the essential difference in the composition of the two materials or preferred the plaster surface to that of the dressed stone, for limestone walls were treated in identically the same manner as gypsum, with one or two exceptions referred to below. Very often the surface of the stone was scored over to give it a better key (as seen in fig. 6).

Exhaustive examination of the whole of the remains on the principal sites reveals ample evidence for reconstructing the condition of the buildings when in state of habitation, and it is clear that practically the whole of the building was finished in plaster.

That it was invariably used on internal walls one may accept without comment, but that its use should extend to the paving of floors is rather less obvious. In many places, however, the plaster can be traced down the

* "The Palace of Knossos," *Annual of the British School at Athens*, IX. p. 133.

wall and returning to the floor without a break (fig. 10). A noteworthy case is that of the "Corridor of the Procession" at Knossos, where a row of fine slabs of gypsum extends down the centre of the floor, the margins being paved with rough blocks of slate. The impression one obtains from seeing this in its present state is that the flooring plaster only extended over the margins, leaving a central footway of polished gypsum; yet there is sufficient evidence to prove that the plaster extended across the whole of the corridor, covering the polished gypsum as well as the rough paving.

FIG. 8.—REMAINS OF THIN PARTITION WALL OF CLAY CASED WITH PLASTER—S.E. QUARTER.
(The wall has been supported by modern brick piers to preserve it.)

The use of plaster on staircases can also be traced in many instances—an example is seen in fig. 11, from the Royal Villa at Knossos. The evidence as regards external walls is equally complete; traces of plaster are found adhering to the outer walls at Knossos, Phæstos, and Hagia Triadha. I have traced it all round the foot of the walls of the great central court at Knossos—these walls for the most part are only standing to the height of a few inches, but the cement fillet covering the joint between the paving stones of the courtyard and the walls is in position in several places, and between it and the wall the plaster can still be traced. Fig. 12 shows this clearly: here a portion of the cement fillet has been removed showing the several layers of which it is formed and the plaster running down to the foot of the wall behind it. This cement necessitates a word in passing: it is essentially a lime concrete, prepared from lime of practically the same composition as that used for the plaster, strengthened by the addition of coarse sand and pebbles. A similar material was generally used for paving the floors of corridors and light wells open to the sky, large smooth pebbles being mixed with the lime to form a durable and at the same time decorative pavement [fig. 13].

FIG. 9.—SECTION OF DOORWAY, THIRTEENTH MAGAZINE, KNOSSOS.
A, fine plaster. B, rough backing. C, rubble wall. D, gypsum block with rebate for door.

An exception must, however, be made to the statement as to the completeness of the evidence in the case of the walls of impluvia, or light wells open to the sky. Here the evidence is conflicting. In some cases, as in that illustrated in fig. 14, remains

of the plaster can be clearly seen on the walls, and at the foot of the wall it is found in position, between the edge of the "terrazza" and the stone. In other cases, as in the open court that lighted the grand staircase at Knossos, it is equally certain that the limestone masonry was left exposed, for one can trace the "terrazza" of the floor running up on to the wall, and not only so, but raised at the edge to form a fillet [fig. 15] : it is certain that if the wall had been plastered this fillet would have been made against it, and we should find remains of

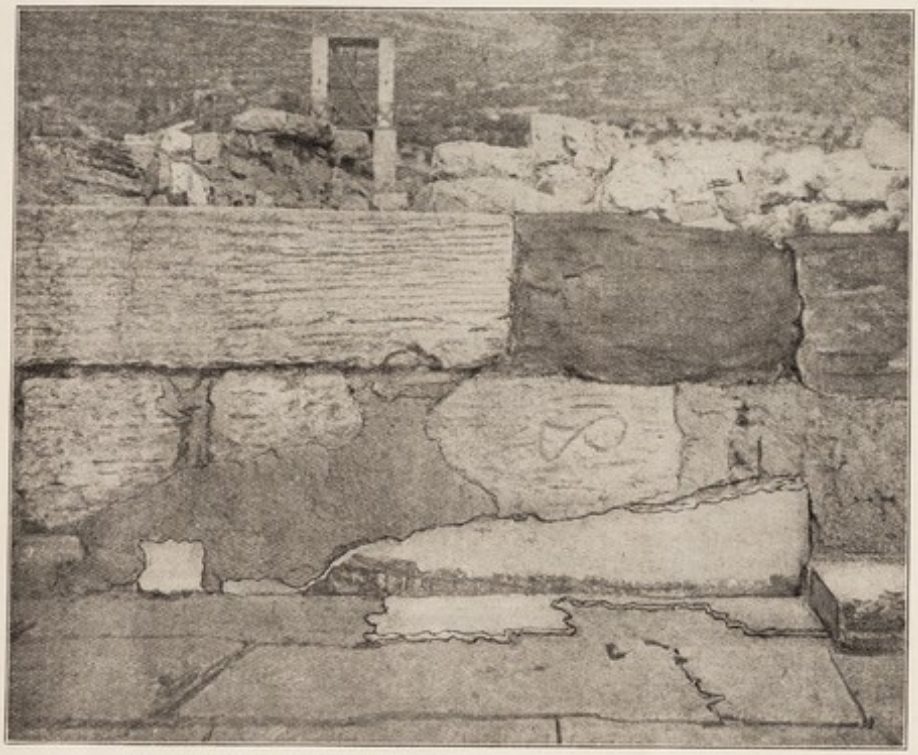


FIG. 10.—REMAINS OF PLASTER ON THE WALL AND FLOOR OF THE WEST PORTICO, KNOSSOS.
(The outlines of the plaster have been strengthened to render them more obvious.)

plaster at the foot as in other cases. Possibly this case is an exception—certainly the balance of evidence is in favour of the general practice having been to finish all walls of whatever character with plaster, and we may conclude that as regards the exterior of a Late Minoan palace, it presented an expanse of white plaster, relieved in places perhaps by flat washes of colour or some decoration, whilst the interior was finished in the same plaster, in places left white, but for the most part decorated with elaborate designs.

THE USE OF PLASTER IN DECORATION.

This brings us to the consideration of the more interesting aspect of Minoan lime plaster —its use as a basis for decoration. Lime plaster offers peculiar facilities for decorative treatment by reason of the fact that if a pigment merely mixed with water is applied to the surface as soon as the initial setting has taken place, it becomes firmly attached by the gradual transformation of the slaked lime into carbonate of lime.

This method of decorative painting, so extensively practised in mediæval times, especially by the Italians, who christened it "fresco" painting,* has certain qualities which cannot be altogether reached by any other method: qualities derived partly from the severe limitations the method imposes on the artist, and partly from the nature of the surface and the entire absence of anything in the way of a vehicle or medium, which in all other processes is necessary to attach the pigments to the surface. The fact that it was only necessary to wash pigment over the freshly rendered plaster in order to colour it permanently must have been discovered in very early times, for it is quite the usual thing to find the Early Minoan plaster coloured a uniform red by a liberal coating of pigment—the fragment from Vasiliki illustrated in fig. 1 is so coloured. This red is the only colour that has been found in Early Minoan work, and one can well understand that it would be the first pigment to be used, for it is what is generally known as red ochre, prepared by burning yellow clay. When they burnt their lime, they would notice that here and there spots of bright red would be developed, which would be traced to impurities in the shape of bands of yellow clay in the limestone. As far as evidence is available, for a considerable period this red pigment was only put on as a flat wash over the surface of the plaster, and rather as a finish to it than with any idea of decorative effect. The main purpose of the plaster was to protect the buildings, and the use of the red pigment has a certain advantage even in this connection as it renders the surface more uniform and slightly less absorbent. From the use of pigment in this way, however, the development of some form of decoration is a natural step. Other coloured substances would be tried, and it would be discovered that any pigment could be attached to the plaster if applied in the same way. By using the clay in its natural state yellow (ochre) would be obtained, and black would be readily prepared either from charcoal or, as was more customary, by powdering carbonaceous shale, whilst the lime itself could be used for white. The accumulation of a palette of such natural pigments is the general course of events in the development of painting amongst all primitive races.

FIG. 11.—PLASTER IN SITU (MARKED A) ON THE STAIRS OF THE "ROYAL VILLA," KNOSSOS.

The development of decorative painting in this way would naturally direct attention to

* The limitation of the term *fresco* to this method of working is not generally observed at the present time. Owing to the fact that fresco is most usually employed in connection with mural painting, the name has been gradually transferred from the process of working to include any form of mural painting, however produced. I propose, however, to limit the term strictly to a painting executed by applying pigments to a caustic lime surface, without the use of medium of any kind.

the possibility of improving on their original plaster, which was but ill-adapted to the purpose, and by adding more and more lime (to condense into a few words the development of centuries) they would gradually arrive at the pure lime plaster of the Late Minoan period. During the Middle Minoan period the palette also was supplemented by the introduction of a blue pigment, not like those previously used, a natural product, but a powdered blue glass prepared by fusing sand with soda, and coloured by silicate of copper. How the introduction of this pigment came about is a matter of speculation—it occurs quite early in the Middle Minoan period, when however it was only employed to a limited extent—probably because it was a costly material at that time. With the growth of decorative painting in later times, however,

FIG. 12.—FOUNDATIONS OF THE WEST WALL, CENTRAL COURT, KNOSSOS, SHOWING THE PLASTER (A) BENEATH THE CEMENT FILLET (B).

it comes more and more into prominence, and its extensive use is a characteristic feature of Late Minoan designs. Its manufacture was also evidently improved in course of time, for the pale greenish blue of the Middle Minoan work bears no comparison with the beautiful colour found in later times. Its long-continued use argues local origin, but it is so closely akin to a pottery glaze as to suggest having been derived from this source, and such vitreous materials are not at all characteristic of Minoan art until quite late—glass, in fact, as a material was scarcely known to the Minoans. On the other hand we find such a blue glass used in pottery from very early times in Egypt, and from the XIth dynasty onwards it was extensively used as a pigment: every stage of its manufacture, proving conclusively that it was manufactured in Egypt, has been traced. We know that from quite early times there was considerable intercourse between the two countries, and that the Minoans exported their red pigment to Egypt,* and in the absence of any evidence as to its manufacture in Crete, it is reasonable to suppose that the blue may have been imported from Egypt in exchange.

* Flinders Petrie, Abydos, ii. 38.

We have already seen that in the Late Minoan period fresco painting was developed to the extent of becoming the characteristic art of the period. Of the peculiarities of Minoan design it is beyond my province to speak,* but I may perhaps indicate the extent to which the art was practised at Knossos when the Minoan civilisation was at its height, as revealed to us by a detailed examination of such fragments of the vast palace as have survived its fall and the subsequent burial of its remains for twenty-five centuries.

There is every reason to believe that, with the possible exception of some of the external walls, the plaster was never left entirely plain, although in some of the less important apartments the decoration was extremely simple. In the "magazines," for example, the only decoration found is a series of bands of red—a broad band 85 cm. from the floor, separated by its own width from a narrow band (seen in fig. 7), and then another similar pair of bands near the ceiling, the remainder of the surface being left in its natural white. This simple decoration is found throughout the labyrinth of rooms surrounding the "magazines," and in the similar areas in the eastern portion of the palace, but in all the more important rooms the surface is entirely decorated in a manner similar to that found centuries later at Pompeii—a characteristic arrangement is that of panels of elaborate figure subjects or symbolical designs, set in a background of deep red. This red background seems to have formed part of the scheme of decoration in the more important halls reserved for ceremonial purposes, and some symbolic meaning was evidently attached to its use. It is probable that this may be connected with the fact that red was the first colour to be used in connection with plaster decoration, and its use, handed down from time immemorial (for at least a thousand years elapsed between the production of the fragment of plaster seen in fig. 1 and that in fig. 2), became associated with the traditions of the race.

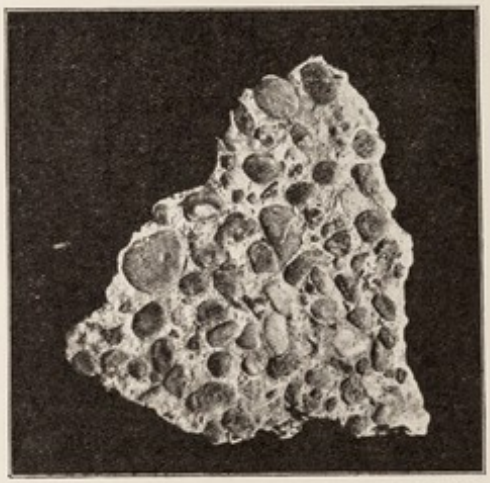


FIG. 13.—TERRAZZA OF LIME CONCRETE, USED FOR PAVING CORRIDORS.
(Exact size of original.)

In what is known as the Domestic Quarter of the palace, however, devoted to the Royal apartments, such as the area surrounding the Hall of the Colonnades, a lighter background was the rule, and very often, as in the Queen's Megaron, a frieze of characteristic spiral design was carried round the walls. In such places as porticos again, the surrounds of the subject panels were decorated to imitate slabs of variegated marble. This is the case, for example, in the antechamber to the Throne Room and the great portico of the West Court. In the latter case the painted surface was mostly burnt away at the time of the conflagration, leaving the white body of the plaster exposed, but remains of it can be traced at the foot of the wall as shown by the dark space in the illustration [fig. 10], marking where the surface was protected from the fire by fallen débris. At Knossos there is no indication that elaborate designs were painted on the floor as was common in later Mycenæan times, but the prevailing colour was the natural white of the plaster, with a broad red band running round about a foot from the walls and the centre of the floor arranged chequerwise in red and white, or black and white.

* A detailed description is given in "Painted Plaster Decoration at Knossos" by Theodore Fyfe, JOURNAL R.I.B.A. December 1902.

Mention must also be made of the fact that the decorative use of the plaster was not confined to painting, great skill being also shown in modelling it before setting to form figures in low relief which were subsequently painted in fresco. These moulded reliefs—life-size models of men and bulls—are some of the finest remains of Minoan art, and must have added immensely to the decorative effect of the plasterwork. They are eloquent testimony to the mastery over the material possessed by the Minoan craftsmen.

This, however, is somewhat of a digression. Returning to the technical aspect of the question, I have stated more than once that one of the great points of interest in connection with the decorative paintings of the Minoans is their bearing on the origin and early development of fresco painting. Not to describe in detail the long series of observations which have led me to assert that fresco technique was almost universally employed in the execution of these paintings, they may be summarised thus :—

FIG. 14.—REMAINS OF PLASTER IN POSITION ON WALL OF LIGHT WELL: CORRIDOR OF THE BAYS, KNOSSOS.

1. Careful observation generally reveals places where the surface of the plaster has been dragged up by the brush in laying on the pigment, and sometimes this is apparent on the most casual examination, as in fig. 16.

2. The dimensions and broad outlines of the design are often set out on the plaster by incised lines, not scratched by a knife on the dry plaster, but made by a blunt point passed over the still soft surface: sometimes it can be clearly seen that straight lines have been made by a stretched string.

3. A thin section examined under the microscope shows that there is no sharp line of demarcation between the painted surface and the body of the plaster, one merging into the other.

4. No medium can be detected, and the painted surface stands prolonged treatment with water, caustic alkali, alcohol, ether, toluene, and other solvents, either hot or cold, without injury.

5. A fragment of the painted surface treated with dilute hydrochloric acid disintegrates with effervescence, the carbonate of lime which binds the particles of pigment dissolving, leaving them in a state of powder.

These facts, taken together and in conjunction with the character of the work as regards design and execution, leave no room for doubt that fresco was the general method of working. At the same time it is quite probable that distemper painting was occasionally employed as an accessory. This was the recognised method of painting in Egypt, and as there was evidently

considerable intercourse between the two countries it is highly probable that it was known to the Minoans. But they can only have employed it occasionally, as a sort of makeshift, for amongst the large number of specimens examined I have only come across one instance of its use. This was on a small fragment which attracted my attention by its exceptional nature, which was explained when I found that some of the colouring of the surface could be washed off, leaving the basis of fresco untouched.

There are, it is true, one or two difficulties in the way of accepting this hypothesis of fresco painting. The huge scale and detailed design of some of the paintings, and the absence of any indication of the thin final coat or "intonaco" characteristic of mediæval work, and of any trace of the joins showing where this "intonaco" was put on fresh for each day's work, is worthy of comment. A more frequent criticism, however, is that it is quite common to find one pigment painted over the top of another—ornament being painted on a wash of colour, or the outline of a figure on a background, for instance, which seems at first sight to point to execution in some form of distemper or tempera on the dry plaster. These facts, however, are not altogether inconsistent with the use of fresco, when one bears in mind the essential difference between the Minoan work and that of Roman or mediæval times—the enormous thickness of the plaster, often over three-quarters of an inch, instead of the one-eighth or less characteristic of later times. This would result in there being a reserve of the soluble calcium hydrate available to fix the pigments for a very much longer period than one is accustomed to regard as possible, and allow of somewhat more deliberate work. The slow setting incidental to such a thick body of plaster would also permit this soluble hydrate to penetrate and weld together superimposed layers of pigment: repeated examination shows that where the design is built up in this way the different layers of colour penetrate one into the other and are bound together only by a film of carbonate of lime.

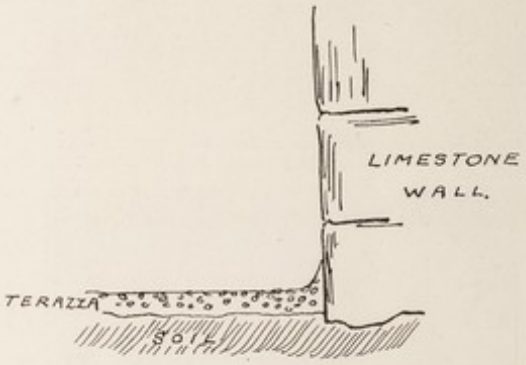


FIG. 15.—DIAGRAM SHOWING STRUCTURE OF FLOORING OF LIGHT WELL OF HALL OF COLONNADES, KNOSSOS.

But probably the explanation lies in their method of working. From a careful study of the designs, both of the remains *in situ* and the restored drawings made by M. Gillieron, it is clear that where figure subjects were to be included in the decoration of a room these were arranged in panels, the remainder of the wall space being either left white, or more usually painted in a flat wash of red, with horizontal borders of red and white bands, or perhaps a frieze of the characteristic spiral design.

This simple work would be executed as the plaster was put on, in the same way as the simple decorations of the "magazines" and other unimportant rooms—probably by the plasterers themselves, or at any rate inferior workmen, the panels to be occupied by the figure subjects being left unplastered. These spaces were then filled in and painted by decorative artists, the decoration of each panel being proceeded with immediately the plastering was finished, the artist working with a rapidity and certainty born of constant practice and long-established tradition.

That this was the method of working is indicated by the general style of design, which may be roughly described as outline and wash in two dimensions, no attempt being made at representing the third dimension or even to indicate anything in the way of shading or folds of

drapery and so forth. Figures are drawn in black outline, filled in with broad washes of colour, on which again details of ornament, &c., are added. The liberal use of what Sir Arthur Evans has described as "artistic shorthand"* is further evidence of the rapidity with which the paintings were executed.

A

B

FIG. 16.—FRAGMENT OF PAINTED PLASTER SHOWING BRUSH MARKS. A, less than natural size. B, portion outlined in A enlarged.

The skill with which figures in low relief were modelled in the plaster, details such as the muscles of the arm being accurately represented, indicates that it was not from any want of skill but rather by deliberate intention that the paintings were executed in this manner. One specimen of plaster in relief which I found in the Museum at Candia provides some evidence of the division of labour in the preparation of these decorations. Here the modelled portion was not continuous with the general surface of the wall but added to the flat surface, for I could trace the line of junction; moreover, the wall had been treated with a thin wash of red on the flat before it was added. Evidently the general wall surface was prepared by the plasterer and the modelling added immediately afterwards by a more skilful worker.

As regards the insertion of the panels this is suggested by the fact that fragments decorated in the characteristic manner employed for the borders of these panels often show a straight clean cut edge, showing that there was a joint in the plaster here, whereas in the corners of the rooms and even at the junction of walls and floor the plaster is returned without a break. In this connection it is interesting to compare the conclusions arrived at by Dr. Mackenzie in his report on the frescoes found in Melos,† which are, as he shows, Cretan in origin. He notices the clean edges which surround the design "as though the picture had been enclosed in a wooden frame," and suggests that such designs may have been prepared in framed panels at Knossos, the centre of the craft, for export.

In the foregoing remarks I have endeavoured to trace the development of the use of lime-plaster and fresco decoration from the earliest times to the second Late Minoan period, when art and civilisation alike suffered a period of eclipse in Crete with the fall of the great Minoan palaces. With the transfer of supremacy to the mainland of Greece, the rise of Tiryns, Mycenæ, &c., and the development of Homeric ages, a fresh chapter opens in the history of decorative paintings, involving many vexed questions, the discussion of which would take us beyond the scope of the present article.

* Provisional Report for 1900: *Annual of the British School at Athens*, vi. p. 47.
† *Journal of Hellenic Studies*, 1904, Supp. 4, pp. 70–77.

No. 3

No. 3049. VOL. LIX. APRIL 28, 1911.

Published every Friday

JOURNAL of the ROYAL SOCIETY OF ARTS

CONTENTS

price to non-members 6d.

LONDON PUBLISHED FOR THE SOCIETY BY GEORGE BELL & SONS, LTD. YORK HOUSE, PORTUGAL ST. W.C.

REGISTERED AS A NEWSPAPER

CONTENTS.

Journal of the Royal Society of Arts.

No. 3,049. VOL. LIX.

FRIDAY, APRIL 28, 1911.

All communications for the Society should be addressed to the Secretary, John Street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 1ST, 8 p.m. (Cantor Lecture.) ALFRED E. H. TUTTON, M.A., D.Sc., F.R.S., "Rock Crystal: its Structure and Uses." (Lecture I.)

WEDNESDAY, MAY 3RD, 8 p.m. (Ordinary Meeting.) A. W. GATTIE, "Improvements in the Transport and Distribution of Goods in London." JAMES SWINBURNE, M.Inst.C.E., F.R.S., will preside.

INDIAN SECTION.

THURSDAY AFTERNOON, APRIL 27TH, Sir ARUNDEL T. ARUNDEL, K.C.S.I., in the chair. A paper on "The Trend of Mineral Development in India" was read by Professor Sir THOMAS HENRY HOLLAND, K.C.I.E., D.Sc., F.R.S.

The paper and discussion will be published in a subsequent number of the *Journal*.

CONVERSAZIONE.

The Society's Conversazione will be held, by permission of the Trustees of the British Museum, in the Galleries of the Natural History Museum, South Kensington, on Tuesday Evening, May 30th, from 9 p.m. to 12.

The Reception, by Sir JOHN CAMERON LAMB, C.B., C.M.G., Chairman, and the other Members of the Council, will be held in the Central Hall from 9 to 10 p.m.

A Selection of Music will be performed by the Band of H.M. Royal Artillery, in the Central Hall, commencing at 9 o'clock.

A Vocal and Instrumental Concert will be given in the Fish Gallery and a Miscellaneous Entertainment in the Shell Gallery, under the direction of Mr. PATRICK KIRWAN, commencing at 9.30 p.m.

The following portions of the Museum will be open:—

The Central Hall, containing cases of specimens illustrating Mimicry; Adaptation of Colour to surrounding conditions; Protective Resemblance; etc. Also specimens illustrating the Food of Fishes, and the Life History of the Eel (East of staircase).

The North Hall, containing the collection of Domesticated Animals.

The Bird Gallery, containing groups of British Birds and Nests; and in the Pavilion, at the West end, an exhibition of the Land and Fresh-water Vertebrate Animals of the British Isles.

The Fish Gallery, containing the Great Basking Shark, the grotesque Deep-sea Fishes (case 44), the Tunny (case 38), the Tarpon and Angler-fish (case 27), and the Lemon-Sole (case 30), etc.

The Shell Gallery, including a life-size model of a Giant Squid (Newfoundland), and of a Giant Octopus (California).

The East and West Corridors on the First Floor, containing the Okapi, African Antelopes, and Giraffes.

Light Refreshments will be supplied at Buffets in the North and South Corridors on the First Floor of the Museum.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. (These cards will be issued shortly.) In addition to this, a limited number of Tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5*s*. each, if purchased before the day of the Conversazione. On that day the price will be raised to 7*s*. 6*d*.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the Offices of the

Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

It will greatly facilitate the arrangements if members requiring additional tickets will apply for them at as early a date as convenient.

The Council reserve the right of stopping the sale of tickets or of raising the price, if it is found necessary, in order to restrict the number of visitors within reasonable limits.

Further particulars as to the musical and other arrangements will be given in the Programmes, which will be distributed on the evening.

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 26th, 1911; Principal Henry A. Miers, M.A., D.Sc., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Boyd, Miss Emma S., 18, King's-road, Southsea, Hants.

Croll, George, Camden House, Chislehurst, Kent.

Holland, William W., Ph.D., Johns Hopkins University, Baltimore, Maryland, U.S.A.

Holman, Arthur, Ishapore, Bengal, India.

Howat, William Frederick, M.D., Hammond, Indiana, U.S.A.

Sanguinetti, Vivian, c/o Dr. H. H. Sanguinetti, 19, Camden House-road, Kensington, W.

Triggs, Bernard, c/o Messrs. Cox & Co., 16, Charing-Cross, S.W., and Royal Bombay Yacht Club, Bombay, India.

Wood, Casey A., D.C.L., M.D., Suite 1208, Chicago Savings Bank Building, State and Madison-streets, Chicago, Illinois, U.S.A.

The following candidates were balloted for and duly elected members of the Society:—

Browell, Colonel Edward Thomas (late R.A.), Merrow House, near Guildford, Surrey.

Cotman, Henry William, The Quadrant, St. Ives Hunts, and the Arts Club, 40, Dover-street, W.

Evans, J. Howell, M.A., M.B., M.Ch. (Oxon.), F.R.C.S., 25, Berkeley-square, W.

Graham, W. L., 33, Bowerdean-street, Fulham, S.W., and Bon Accord Sheet Metal Works, Townmead-road, Fulham, S.W.

Hudson, Lieut.-Colonel Sir William Brereton, K.C.I.E., Fairholme, West Kensington, W.

Khan, Khur Shaid Ali, c/o Messrs. Henry Adams and Son, 60, Queen Victoria-street, E.C.

Provis, Charles Herbert, Highfield, Mutley-road, Plymouth.

The paper read was—

THE PRODUCTION AND IDENTIFICATION OF ARTIFICIAL GEMS.

By Noel Heaton, B.Sc., F.C.S.*

In order to make the object and scope of this paper clear, I may say at once that I have not anything original to bring before you, or anything that is particularly new to those who have followed recent work on the artificial production of precious minerals. My object is more to review the whole subject in a comprehensive manner from its scientific and economic aspect, and particularly to bring the records of this Society up to date, as it were, by describing such advances as have been made since the subject of precious stones was last discussed in this room.

During recent years the production of artificial gems on a commercial scale has become an accomplished fact, and a great many misconceptions and misleading statements have been made as to the relation which these productions bear to natural products on the one hand and imitation gems on the other. It may therefore be of some use to make the matter clear by describing as fully as circumstances permit what has been done in this direction and what has not been done; what is practicable and what is impracticable in the present state of our knowledge.

I suppose there are few subjects of interest from so many points of view as that of precious stones. The beauty and rarity of fine specimens has from time immemorial rendered them the most treasured of possessions. With the romance that surrounds this aspect of the question we have nothing whatever to do to-night, except to bear in mind that on account of their great value men have for centuries strained their ingenuity to solve the mystery that surrounds the origin of such stones, and amass wealth by producing them at will instead of by the laborious and highly speculative process of digging for them in the earth.

Until the development of modern science and accurate methods of investigation, this problem

* Consulting expert to the Burma Ruby Mines

resisted all attempts at solution, and it is, in fact, only within the last few years that the artificial production of any species of gem on a commercial scale has become practicable.

Of course, one can cut the Gordian knot by preparing a colourable imitation of the real thing, but that is quite another matter, and I want to make it quite clear, at this point, that I propose to limit the term "artificial" to such productions as possess the same chemical composition and physical constants as the natural stones, differing from them only in minute details consequent upon their being produced in the laboratory instead of being dug out of the earth; all other makeshifts being properly described as "imitations." The production of *imitation* gems is by no means a modern invention, as is doubtless well known to you. To go no further back than the time of the Roman Empire, the master glassmakers of the dawn of our era, whose skill and knowledge of glassmaking one appreciates more highly the more one investigates the industrial life of those times, were able to imitate almost any precious stone exactly, as far as outward appearance went, in coloured glass—and not only the transparent gems, but the structure of such semi-precious stones as agate, cornelian, lapis, and porphyry. It would be quite out of place to devote any time to-night to this historical aspect of imitation gems, but I cannot refrain from alluding to the remarkable examples of such imitations found by Mr. Woolley at Karanóg,* from which it is difficult to resist the conclusion that in quite early times Nubia was the centre of this industry. To judge by the stories one reads about jewels in those times—stories of the Emperor Comnenus, for example—one suspects that the glassmakers turned their skill in this direction to some account and considerable profit on behalf of an ignorant and somewhat credulous aristocracy; for in those days, and, in fact, until quite recently, not only was the nomenclature of gems very vague, but methods of identification were chiefly remarkable for their non-existence.

The chief criterion of a precious stone was its colour, so much so that throughout mediaeval times blue glass was known as sapphire and green glass as beryl, etc., giving rise to the legend that in the time of Queen Elizabeth windows were glazed with sheets of beryl.* As the tendency still lingers to regard all red stones as rubies and green as emeralds, and so on, I would like to make it clear at this point that colour is really quite an accidental property of precious stones: the substance of which nearly every species of transparent gem is essentially composed is colourless, and the colour is really produced by minute proportions of impurity.

This being the case, we find that on the one hand the same species of gem may exist in a large variety of colours, and on the other hand that a colour characteristically associated with one gem may often be found in another having essentially different composition and properties. Owing to this confusion it was very difficult to draw the line between a genuine and imitation stone until the various species of gem stone were accurately defined and their names clearly associated with particular composition and properties, the

TABLE I.

PROPERTIES INFLUENCING THE VALUE OF PRECIOUS STONES AND USED AS MEANS OF IDENTIFICATION.

- BEAUTY
  - Colour.
  - Structure
    - Cleavage.
    - Lamination.
    - Inclusions.
  - Optical Properties
    - Refractive Power [Refractometer].
    - Double Refraction [Polariscope].
    - Pleochroism [Dichroscope].
    - Dispersion.
    - Absorption Spectrum [Spectroscope].
- DURABILITY
  - Hardness [Hardness Points].
  - Toughness.
  - Chemical Composition.
- ADDITIONAL MEANS OF IDENTIFICATION
  - Specific Gravity.
  - Thermal Conductivity.
  - X-Rays.

* "Karanóg," by C. L. Woolley and D. Randall. MacIver: Philadelphia Museum, 1910.

* This is quoted in Hollingshed. We read in Theophilus (II., Cap. xii.) of "tabulas saphiri pretiosas ac satis utiles in fenestris." In a previous paper (*Journal*, March 15th, 1907) I have shown how the name jet was applied indifferently to the natural pr

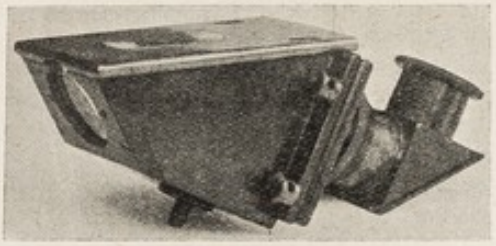
determination of which forms, at the present time, a means of distinguishing one from another, and also of deciding whether an alleged gem is genuine or imitation with ease and certainty.

The scientific examination and identification of gems in this manner is a matter of the greatest interest, but it would take far too much time to discuss it in detail, and it is quite unnecessary to do so, because it has already been brought before the Society most exhaustively by our chairman, Dr. Miers.* I propose, therefore, merely to remind you of the main points by means of the accompanying summary (Table I.).

In order to bring this matter up to date in the records of the Society, however, I must refer briefly to one or two particulars in which advance has been made since the time of these lectures.

The most important properties of a precious stone are those depending upon its refractive powers. Until recently the accurate determination of the refractive index of a stone was a matter involving the use of complicated and expensive instruments, and a matter for the skilled mineralogist rather than the practical jeweller. It is true that at the time Dr. Miers published his lectures there existed an instrument known as the Reflectometer, but the determination of the refractive index with this was a matter of some difficulty even in skilled hands, and its value for commercial purposes was very small. Since that time, however, thanks to the ingenuity of Dr. Herbert Smith, this instrument has been improved out of all recognition, and in its place we have the Herbert Smith Refractometer (Fig. 1), by means of which anyone of normal commonsense can determine the refractive index of a stone in a few seconds without even removing it from its setting, and which, with a little practice, will also enable one to determine with similar ease the amount and kind of double refraction and the degree of dispersion.

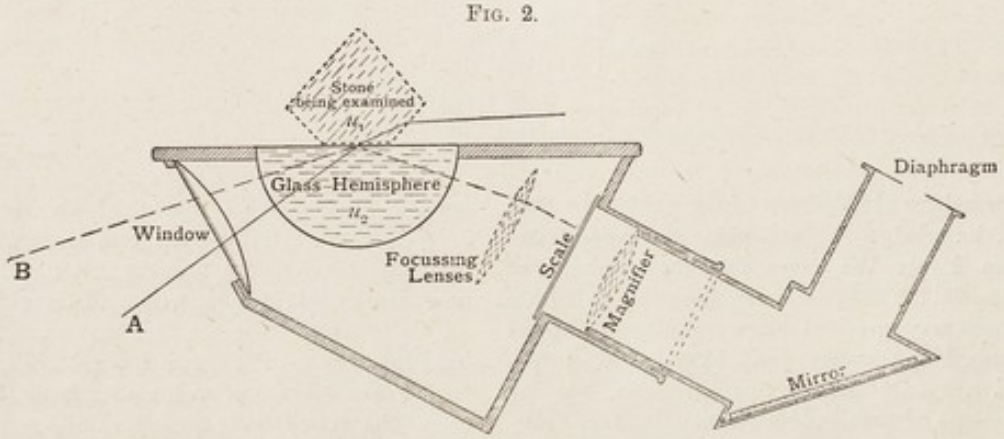
Fig. 1.



The Herbert Smith Refractometer.

As will be seen from the diagram (Fig. 2), the main principle of the instrument is the same as that of the reflectometer, the refractive index being measured against a standard of highly refracting glass by means of the angle of total reflection, which of course diminishes, the nearer the index of the stone approaches that of the standard. It is, however, in the details of construction that such a marked advance has been made, and it is these details which make all the difference in practical work. To use this instrument all that has to be done is to place the stone under examination in optical contact with the flat surface of the dense glass, and arrange it so that a good light (preferably monochromatic) enters the instrument through the lower lenticular opening, when the refractive index is read off directly on a scale, without calculation.*

Fig. 2.



Construction of the Herbert Smith Refractometer.

Some little advance has also been made in the construction of the Dichroscope for determining pleochroism. As will be seen from the

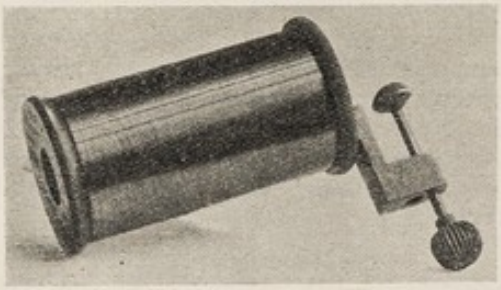
* Cantor Lectures on Precious Stones, April, 1896.

* It is impossible here to give any detailed account of the construction and use of this instrument. Full particulars will be found in "The Herbert Smith Refractometer, published by J. H. Steward, 406, Strand.

illustration (Fig. 3), the instrument in use to-day is provided with a revolving holder tipped with wax, to which the stone is readily fixed, leaving both hands free. A detail, but again it is such details that count in practice.

Taking the properties of precious stones as a whole, the great point about them is the remarkable combination of qualities; it is not so much that they have optical properties which make them extraordinarily beautiful, or that they have

FIG. 3.



THE DICHROSCOPE.

remarkable hardness and durability, but they have *both*, and it is the impossibility of reproducing this combination in any other material that renders the detection of imitations a matter of ease in the hands of anyone familiar with the facts.

Of course, glass is the obvious material to use in the production of imitation gems, and, as I have indicated, it has been so used from time immemorial. And, in later times, while science was equipping the expert in precious stones with the means of identifying them with certainty, the maker of imitations was also invoking its aid in the production of more successful imitations.

In modern times the manufacture of imitation gems on scientific lines was introduced by Strasser in Vienna; hence the name "strass," although "paste" is the more commonly used term.

The finest of such modern paste bears little relation to the clumsy imitations of early times; the glass is specially prepared in order to combine, as far as possible, the necessary optical qualities with a fair amount of durability. It is well known that by using lead instead of lime as the basic constituent, the refractive index and dispersive power of glass are much increased, and by replacing the alkaline constituent by thallium oxide in the same manner the refractive index may be raised as high as 1·96 and the dispersion to 0·049.* By adjusting the composition in this way, and preparing the glass with the greatest regard to the purity of the materials, manipulating it, moreover, in a similar elaborate manner to that employed in the production of glass for optical instruments, in order to secure the utmost freedom from striation and inclusions, it is possible to imitate any precious stone accurately, as far as outward appearance is concerned.

The trouble is, however, that with glass the more you increase its refractive power in this way the softer and less durable it becomes, until you find that the very "dense" flint used for the refractometer, having a refractive index of 1·8049, is so soft that it has to be handled with great care to avoid scratches, and so little resistant to decay that in a comparatively short time the exposed

TABLE II.

IDENTIFICATION OF IMITATION GEMS.

PASTE.	STONES.
Index of Refraction rarely exceeds 1·65.	Index of Refraction ranging up to 2·4.
Single Refracting, or false double Refracting owing to strain.	Double Refracting, with exception of Diamond, Garnet, and Spinel.
Never Pleochroic.	Often strongly Pleochroic when coloured.
Hardness always below 7.	Hardness 7 or over (with a few exceptions).
Specific Gravity usually above 4.	Specific Gravity usually below 4.
Thermal Conductivity low.	Thermal Conductivity comparatively high.
Opaque to X-Rays.	Translucent or transparent to X-Rays.
Generally show spherical bubbles and curved striae.	Frequently show lamination or inclusions.

* These are the constants given for the Jena glass, No. S. 57: the specific gravity is 6·33. Refractive index of diamond is 2·4, and dispersion 0·057.

surface becomes corroded, which is the one weak point of this instrument. It is true that this softness may be counteracted to some extent by further adjustment of the composition, adding a proportion of alumina and zinc, and by careful thermal treatment of the finished stone in some such manner as that originally introduced by Bastie, in which the glass is case-hardened by plunging whilst hot into a bath of oil. In some of the best modern paste I have found a refractive index of over 1·6 combined with a hardness close on that of quartz, but this is the absolute limit, and it is not possible in any way to obtain a paste that cannot be scratched with a hardened steel point. Paste can also be readily identified by means of the scientific tests, as indicated in Table II.

The most important point to remember about paste, however, is its lack of durability; it is not only too soft to stand much wear, but its composition is so unstable that it rapidly deteriorates and loses its brilliancy on exposure. You will see, therefore, that although there is a certain legitimate scope for such paste imitations they are very unsatisfactory substitutes for the genuine article. This being the case, as scientific knowledge has advanced, attention has been more and more concentrated on the problem of producing by artificial means the actual minerals found in nature, and thus obtaining what I have defined as artificial in contradistinction to imitation jewels, having both the beauty and durability of the natural article without the objectional concomitant of enormous cost.

TABLE III.

Composition of the Principal Precious Stones.

	Species.	Variety.	Composition.
Element	Diamond	—	Carbon.
Oxides	Corundum	Ruby.	Oxide of Aluminium.
		Sapphire	
		Oriental Amethyst, etc.	
	Quartz	Crystal.	Silica.
		Amethyst	
		Cairngorm, etc.	
Aluminates	Spinel	Balas Ruby, etc.	Magnesium Aluminate.
	Chrysoberyl	Cymophane	Beryllium Aluminate.
		Alexandrite	
Silicates	Beryl	Emerald	Beryllium Aluminium Silicate.
		Aquamarine	
	Garnet	Hessonite	Calcium Aluminium Silicate.
		Pyrope	Magnesium Aluminium Silicate.
		Almandine	Iron Aluminium Silicate.
		Demantoid, etc.	Calcium Iron Silicate.
	Olivene	(Peridot)	Magnesium Iron Silicate.
	Sphene	—	Calcium Titanium Silicate.
	Spodumene	(Kunzite)	Lithium Aluminium Silicate.
	Topaz	—	Aluminium Fluo-Silicate.
	Tourmaline	—	Complex Alkali-Lime-Alumina Silicate.
	Zircon	Jargoon	Zirconium Silicate.
		Hyacinth	
	Turquoise	—	Hydrous Aluminium Phosphate.
	Opal	—	Hydrous Silica.
	Pearl	—	Calcium Carbonate.

The first point to be considered in attacking this problem is the composition of the stone, as it is obvious that, other things being equal, the possibilities of success are greater with one of simple than one of comparatively complicated composition. One also has to consider, however, the economic aspect—it is not much use devoting time and ingenuity to the production of an artificial stone when the natural one is so common that the cost of the two would be practically identical.

Taking these two points in conjunction, and

confining our attention for the moment to the transparent stones as summarised in Table III., the diamond appears to offer the most promising field for attack and corundum comes next, and we find that the main attempts at artificial production centre round these species. From the point of view of composition alone, quartz is the most simple, but it is so common in nature as to render its artificial production scarcely worth while. The aluminate group offers some attraction, but the artificial production of crystalline silicates on a large scale is a very difficult problem, and, with the exception of the emerald, the stones comprised in this group are so freely distributed in nature as to render their artificial production a matter of academic rather than industrial interest.

It is unnecessary to discuss at any length the artificial production of the diamond*—the problem has been attacked by numerous scientists, and was solved by Moissan some years ago. Some fifteen years ago, on the occasion of a visit to Paris, I had the privilege of witnessing the production of his diamonds, prepared, as all the world knows, by saturating iron with carbon at the temperature of the electric arc and plunging the molten mass into cold water. The mass of iron is then dissolved in acid and the residue subjected to a laborious process of extraction, the diamonds being picked out by aid of the microscope. The largest diamond that has been produced in this way is barely visible to the naked eye, however, and when I say that the problem of their production has been solved, I mean from the scientific point of view.

The artificial production of the diamond is, in fact, far more complicated than it appears at first sight. If it were only a matter of obtaining the necessary high temperature to fuse the carbon to obtain it in the crystalline condition it would be simple—such high temperatures are readily obtained nowadays by means of the electric furnace and the oxy-acetylene flame—but carbon is one of those substances which pass direct from the solid to the gaseous state under ordinary atmospheric conditions, and only assumes the liquid condition under enormous pressure. The combination of high temperature and enormous pressure can be obtained momentarily by Moissan's ingenious process, but to obtain crystals of any size it is necessary to conduct the operation on a very large scale and to maintain the combined temperature and pressure for a sufficient length of time to allow the liquid carbon to separate out from its matrix; moreover, the entire operation must be conducted out of contact with air, for carbon rapidly combines with oxygen at high temperatures.

Commercially, we are as far from being able to produce artificial diamonds as in the days of the alchemists. It is, perhaps, a bold thing to say that no such thing as an artificial diamond will ever be placed on the market, but one can safely assert that so far as our knowledge stands at present it is impracticable. In saying this, I am quite aware that statements as to the commercial production of synthetic diamonds being an accomplished fact have quite recently appeared broadcast in the public press, but those who are responsible for such statements are, shall we say, under a misapprehension as to the meaning generally conveyed by the term "synthetic," and are unable to follow the distinction I have drawn between an artificial gem and an imitation.

To pass on to corundum, the problem of its artificial production is very much simplified by the fact that its composition is oxide of aluminium, and alumina—which is, therefore, its amorphous equivalent—fuses to a liquid under ordinary atmospheric pressure at a temperature somewhere about 2,000° C. (the exact point has not as yet been determined), and being the only stable oxide of a strongly basic metal, it can be heated in air without any change.

The chief problem to be faced, therefore, is that of attaining the necessary temperature, and it is not surprising that crystalline alumina was produced as a scientific curiosity as far back as the commencement of the nineteenth century. It is at this time that we first begin to hear of the oxy-hydrogen blowpipe (or the gas blowpipe as it was then called), and in a book published in 1819,* describing various experiments with this new apparatus, we read that "two rubies were placed upon charcoal and exposed to the flame of the gas blowpipe . . . after suffering it to become cold . . . the two rubies were melted into one bead." This hint does not appear to have been followed up for some considerable time, however, and the earlier experimenters in the production of artificial gems worked in another direction; they were unable to obtain products of commercial utility, because although they succeeded in obtaining crystalline alumina, it was produced

* A complete account is given in "Diamonds," by Sir William Crookes (Harper's Library of Living Thought).

* "The Gas Blowpipe," by Dr. E. D. Clarke.

under conditions which resulted in the formation of a mass of small crystals, almost microscopic in size. Moreover, the form of these crystals was that of the hexagonal plate which is the fundamental form of corundum, and such a form would be useless for cutting even when of considerable area, owing to its thinness. Thus Gaudin, who appears to have been one of the first to attain any success in this direction, obtained a mass of such crystals by fusing alum and potassium sulphate in a closed crucible. Ebelman obtained similar results by fusing alumina with borax, and later Deville and Caron used aluminium fluoride and boric acid. All these attempts yielded similar results, as in each case fusion was obtained by the aid of a substance melting at a lower temperature which acted as a solvent. Consequently the alumina crystallised out in much the same manner as a salt crystallises from a saturated solution, and to obtain sufficiently large crystals to be of practical use it would be necessary to conduct the experiment on a very large scale, and subject the fused mass to very slow and carefully-regulated cooling.

In 1877 Fremy and Feil attempted to get over this difficulty by using lead oxide as the flux and employing a crucible composed of highly-acid clay. On heating up the mixture in such a crucible the lead oxide melts and combines with the alumina to form lead aluminate, and on further heating this reacts with the silica of the fire-clay, forming lead silicate and setting free the alumina, which crystallises out. But although very much larger crystals were obtained by this ingenious process they had the same form, and were too thin for industrial employment.*

Some time earlier than this, however, we hear of the oxy-hydrogen blowpipe again, for Gaudin had noticed (as Clarke did in 1819) that by introducing alumina into the flame of an oxy-hydrogen blowpipe he could obtain globules of fused alumina similar to the borax beads one makes in the ordinary blowpipe. Gaudin appears to have taken it for granted that these beads were amorphous—that is, an alumina glass—and it was not realised until many years later that they were really identical in all their properties with natural crystalline corundum. When this was realised, the commercial production of corundum became only a matter of detail.

Having obtained this further point, the idea immediately suggests itself of converting small and useless stones into valuable gems by fusing them together into one, and, as a matter of fact, "reconstructed rubies"—as stones produced by this method are now generally called—made in this manner were the first artificial gems to be prepared on a commercial scale. These were introduced some quarter of a century ago under the name of "Geneva rubies," and were offered as, and realised the price of, natural stones, until the method of their production became apparent.

It will, of course, be well understood that the experiments I have briefly indicated towards the artificial production of corundum had as their immediate objective the formation of ruby, that being by far the most valuable variety. It had long been known that the colour of the ruby was due to a trace of chromium, and by adding a small proportion of potassium or ammonium chromate to their mixture, Fremy and Feil reproduced accurately the colour of the ruby in their crystalline flakes.

The process of producing reconstructed rubies by means of the oxy-hydrogen blowpipe is, roughly, as follows:—The residue from cutting rubies and small worthless stones is broken into coarse sand, a small quantity of which is placed on the centre of a disc of platinum; this is then carefully brought to the fusion point, care being taken at this stage not to raise the temperature to such an extent as to melt the platinum support. As soon as this mass is fused it serves to protect the platinum, and the reconstructed ruby can be built up on it by adding the fragments of ruby one at a time by means of small platinum forceps. These pieces have to be dropped on with great care in order to secure incorporation with the mass and prevent as far as possible the formation of air bubbles. It will be readily understood that this process is a tedious and laborious one, and, in fact, the formation of masses of sufficient size to yield large stones on cutting is a matter of such difficulty that the cost of production is very high.

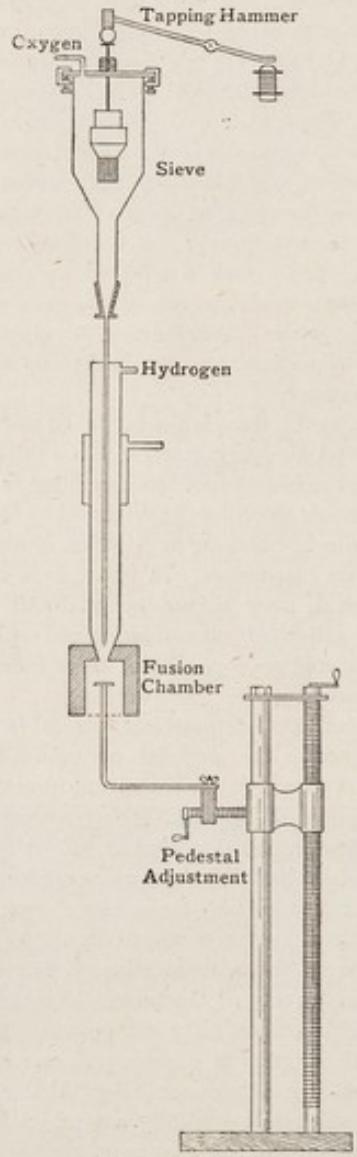
Just about seven years ago, however, Verneuil* overcame this restriction when he hit on the extremely ingenious idea of introducing the raw material through the blowpipe, and thus placing it on the support automatically. The diagram (Fig. 4) shows the principle of his apparatus. The blowpipe is arranged vertically over a small insulated chamber containing the

* For a full account of the history of these earlier attempts, see "La Synthèse du Rubis," by F. Fremy, 1891.

* "Mémoire sur la reproduction artificielle du rubis par fusion," M. A. Verneuil, *Annales de Chimie et de Physique*, Sept., 1904.

support on which the mass is to be built up. The oxygen tube communicates at its upper extremity with a funnel-shaped hopper, in which is suspended a small sieve filled with the raw material, which is rhythmically shaken by means of a small hammer actuated by an electro-magnet or cam. Each time the hammer taps the support of the sieve, causing it to

FIG. 4.

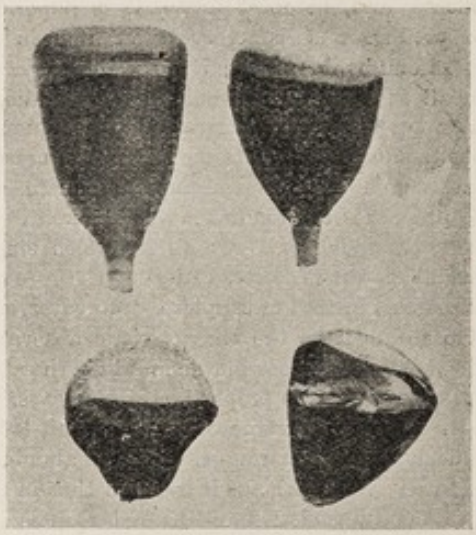


PRINCIPLE OF VERNEUIL'S APPARATUS FOR PRODUCTION OF ARTIFICIAL CORUNDUM.

vibrate, a small quantity of the powder falls through into the tube below, and, carried along by the gas, passes out at its lower extremity into the zone of flame, where it is immediately raised to the fusion point, and falls as a melted globule on to the support below.

As seen in the diagram, this support is arranged with a screw adjustment, so that as the mass of corundum is gradually built up by the constant addition of fresh globules the surface can be kept at a constant level, and the portion already formed removed from the zone of heating so as to allow it to stiffen. When the apparatus is first started the blowpipe is adjusted so as to give a comparatively cool flame, and the powder is admitted slowly. By this means a small "stalk" is formed, which insulates the mass from the support and prevents the fusion of the latter. When this has been formed the full pressure of the blowpipe is put on and the rate of admission increased, with the consequent formation of a "boule," as it is termed, having the shape of a pear as illustrated in Fig. 5.

FIG. 5.



"BOULES" OF ARTIFICIAL CORUNDUM.

With this apparatus a boule weighing some twenty to thirty carats, and capable of yielding two cut stones of about six carats each, can be prepared in about half an hour almost automatically, a single operator being able to control several machines. The boules, on cooling, very often split in half in the direction of their growth, as in the lower example seen in Fig. 5, and this is a convenience rather than otherwise, as the resulting shape can be cut to greater advantage.

In the first instance reconstructed rubies were made in this way after the manner introduced by Gaudin, the material fed into the blowpipe being pulverised rubies and chips, and this method is still employed by some workers. But more commonly nowadays the corundum is produced direct from amorphous alumina by using pure ammonium alum as the raw material. On reaching the flame this decomposes, the

ammonia and sulphuric acid volatilising, leaving the alumina. Stones made by this process are generally known as "synthetic," as distinct from "reconstructed," although, of course, to be pedantic, the process is one of decomposition rather than synthesis.

The "synthetic" corundum produced in this way, if pure ammonium alum is used, is, of course, colourless, and can be used as artificial white sapphire. If a small proportion of chrome alum is added, the resulting stones are rubies, and other colours may be produced in the same way. For a long time all attempts to reproduce the fine blue of the sapphire failed, because, following the apparent analogy of silicates, cobalt was invariably employed as the colouring agent. This, however, does not readily form an aluminate in the same way that it does a silicate, and, in consequence, it is impossible to produce a satisfactory colouration in the corundum by its means; it is possible to get the cobalt in a state of combination by adding a large proportion of magnesia to the alumina, but then the product formed is not a crystalline alumina but magnesium aluminate, and its properties are fundamentally different. Its refractive index is lower, its refraction single, and its hardness lower. In fact, the result is blue spinel instead of sapphire. Moreover, such blue stones have the characteristic absorption of cobalt, and appear purple in a light that does not contain a large proportion of blue rays.

In 1908 Paris attempted to avoid this latter difficulty by preparing a calcium aluminate coloured with cobalt, as it is found that in this case the transmission of the red rays is less pronounced. But the calcium aluminate so formed is not crystalline at all, but amorphous. A year or so ago, however, the problem of producing synthetic sapphire was finally solved by the use of titanium oxide, a very unexpected result, considering the chemical position of this element. With this last advance the artificial production of the corundum gem-stone may be considered to be completely solved, and cut stones can now be obtained in every variety of colour, from pure white to ruby and sapphire, at prices ranging from four to ten shillings a carat, according to colour, quality and size.

Whatever may be their economic importance, a very much debated question, there can be no doubt as to the scientific interest of this group of artificial gems. In the first place it is a matter of some interest that a mass of fused material formed in this way should not only be crystalline but possess all the characteristics of a single crystal. Crystallographers are agreed that each boule is a single crystalline individual, with the axis roughly perpendicular to the plane of formation—that is to say, running from the point of attachment of the pedestal to the top of the mass. On the top of the boule one invariably finds a mass of symmetrically-arranged facets, which Dr. Herbert Smith has found to correspond with the fundamental rhombohedron of corundum. Judging by analogy with other materials, one would expect at first sight that a fused mass formed in this way would be either a heterogeneous mass of minute crystals, or entirely amorphous, possessing the structure characteristic of glass. It is well known, for example, that under similar conditions pure silica yields "quartz glass," which is extensively manufactured at the present time. One is tempted to dwell upon this point, and discuss its bearing on such matters as the devitrification of glass, but it would be entirely out of place to do so in the present paper.

Then, again, there is the matter of colouration. One would like very much to know what is the state of combination of the chromium in a ruby, and whether the colour is produced by chromium aluminate in solution or metallic chromium in molecular suspension. In glass, as is now well established, this colour is produced by the optical effect of ultra-microscopic spheres of metallic gold or copper, but there seems to be no parallel between the two cases.

A point of more practical interest is the fact that although the artificial corundum is a true crystal it possesses the shape and formation of a congealed liquid or glass. The practical interest of this lies in the fact that it affords the only means of distinction between this artificial corundum and the naturally-formed gem-stone. Being of exactly the same composition and crystalline structure as the natural mineral, it cannot be identified by any of the physical tests I briefly referred to above. For all practical purposes the artificial ruby *is a ruby*, and one can only deny that it is a "genuine ruby" if this word is held to connote essentially a product found in the earth and not made by man.

And yet, owing to the curious anomaly of its structure, the artificial product can almost invariably be distinguished from the natural with the greatest ease. In the naturally-formed stone any foreign matter which may be present is coerced into following the lines of growth of the crystal, and more particularly bubbles of gas which may be present in the liquid are

distorted from their natural shape so as to accord with this symmetrical growth. It is the great exception to find a natural ruby entirely free from such inclusions, which generally form irregular cavities with a decided tendency to geometrical shape.

It is very common also to find the structure

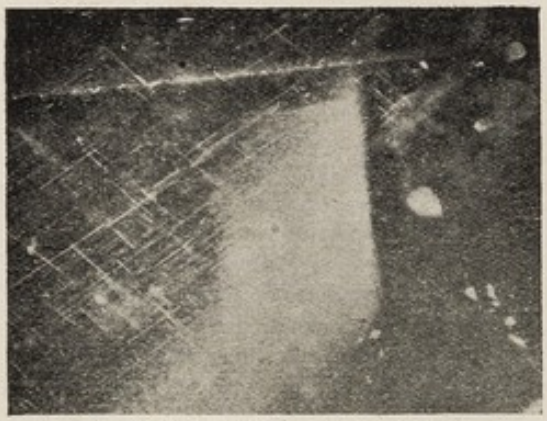
Fig. 6.

Section of Natural Ruby, × 10.

technically known as "silk" caused by microscopic bubbles drawn out into a series of parallel canals, all lying in one plane. Any variation of colour in different portions of the stone also follows the lines of growth in this manner (Figs. 6 and 7).

In the artificially-produced corundum, on the other hand, although the particles arrange themselves symmetrically, any air bubbles that are entangled in the successive globules remain undisturbed, and appear as naturally spherical bubbles in the finished product; and, moreover, if one globule differs slightly from another in the proportion of chromium, the resulting

Fig. 7.

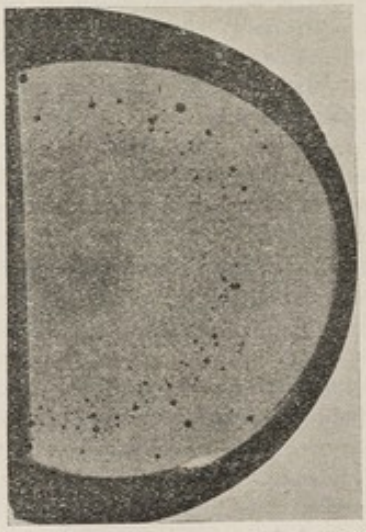


Section of Natural Ruby, × 100.

difference in colour follows the form of the mass as a whole, the zones of colour being circular (Fig. 8).

As some of the air entangled between the fine particles fed into the blowpipe almost invariably fails to make its escape during the brief fusion, the presence and form of the bubbles is in this way sufficient to identify the artificial process of formation.

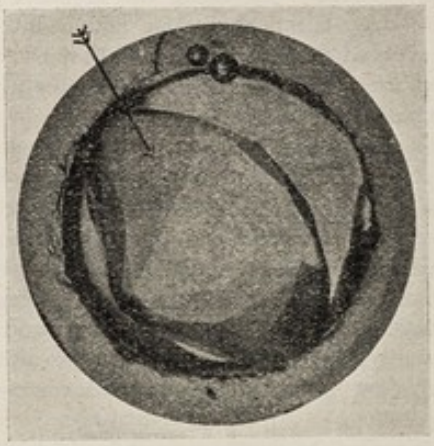
Fig. 8.



Section of Artificial Ruby, × 10.

In the great majority of cases examination of the cut stone with a lens is sufficient to decide the point, but in doubtful cases a more minute examination may be made by placing the stone in a little cell filled with highly-refracting liquid, in order to secure regular illumination, and examining it under the microscope by transmitted light, when the minutest trace of structure can be detected (Fig. 9). In

Fig. 9.



Small Artificial Sapphire, Mounted in Cell, × 10, Shewing Minute Bubbles.

the case of an absolutely flawless stone it would be impossible to decide whether it were natural or artificial, but such stones are so rare that this case is almost theoretical.

It is claimed in some quarters, it is true, that "experts" can invariably distinguish the artificial product merely by reference to the colour, which is said never to be exactly the same as that of the natural stone, much as this latter varies. Personally, however, I am rather sceptical on this point, as one knows that experts claim in a similar manner to distinguish between one species of natural gem-stone and another by colour alone, and their results are not *always* in accordance with scientific tests. At any rate such dexterity can only be acquired by a life-time of specialised experience.

As I have already indicated, spinels may be produced artificially by the same process as corundum, adding the necessary magnesia to the alumina, and the same remarks apply to the production and identification of this species as to corundum, the artificial stone being identical with the natural in all respects except those to which I have just referred.

As regards the remaining transparent gem-stones, which fall into a group by reason of the fact that they contain silica as an essential component, their artificial production is of little importance. They cannot be produced by the same process as corundum, owing to the fact, already alluded to, that under such conditions both pure silica and compound silicates yield an amorphous product, which has not the optical properties of the natural stone. One is constrained, for the artificial production of the crystalline material, to fall back upon methods similar to those employed in the earlier attempts to obtain ruby—obtaining the requisite composition by chemical reaction and maintaining the mass at a temperature just above its fusion point for a sufficient time to allow the silicate to crystallise out.

Topaz, garnets, and zircon have been produced in this way experimentally as a matter of scientific interest, but the small stones produced have no commercial value, and to describe their production in detail would only weary you to no purpose. The majority of these stones are of such common occurrence in nature, and consequently of such little value, that their artificial production in this manner is not a commercial proposition.

An exception, however, must be made in the case of emerald, which ranks next in value to corundum, and many attempts have been made to produce it artificially. Reconstructed emeralds have been made by the Verneuil process, but these are, of course, amorphous, and do not possess the double refraction and other properties consequent upon the crystalline structure of the natural stone. The problem of producing this stone artificially has not as yet been solved in fact. I am quite aware in saying this that recent newspaper reports lead one to believe otherwise, but, as in the case of the diamond, such reports indicate either remarkable foresight on the part of the writers or show that their imagination is developed at the expense of their powers of accurate observation.

There remain now to be considered those precious stones which are opaque, and owe their beauty entirely to colour and structure.

Turquoise is a stone formed under conditions which are easy to reproduce, and its artificial production was successfully accomplished, many years ago, by precipitating hydrated phosphate of aluminium with the requisite proportion of copper phosphate to give it the colour, and subjecting the precipitate whilst still damp to hydraulic pressure for a considerable time. Prepared in this way the artificial turquoise is so nearly identical with the natural that its identification as a matter of considerable difficulty. There is, however, generally a slight difference in the specific gravity, hardness, and index of refraction (when this can be measured), which will serve to distinguish it on careful examination. The only point in which there is any decided difference between the two is the behaviour on heating, but as this involves the destruction of the stone it cannot be offered as a practical test.

Opal consists essentially of what is known as colloid silica, that is, silica in the amorphous state and combined with water. The play of colour one associates with it is entirely an optical effect, due to an accidental structure of the stone, which is permeated by a number of minute fissures, between which a thin film of air penetrates, the extreme thinness of this film causing the optical effect known as interference. If a piece of opal is powdered it is no longer coloured, as would be the case with a ruby or sapphire, but yields a dirty white powder, and generally a specimen of opal, as found, only shows the structure in parts, the remainder being dull and lustreless like flint.

This peculiar structure is, moreover, by no means confined to opal, but may occur in any mineral deposited under similar conditions. In the mineral known as Lumachello, or fire-marble, for example, the same effect is seen in a lime-stone. But opal is the only mineral which combines this structure with sufficient durability for use as a gem-stone, and in this connection

it should be remembered that, as a matter of fact, it only just possesses sufficient hardness for this purpose, and is one of the softest and least durable of all the precious stones. This fact, combined with the fragility consequent upon its structure, has involved the opal in a mass of superstition and romance from time immemorial.

Although it has this unfortunate drawback, opal is, at any rate in my estimation, the most beautiful of the precious stones, and when one appreciates the reason of its beauty it will be readily understood that its artificial production, or even successful imitation, presents almost insuperable difficulties.

It is true that a somewhat similar play of colour can be imparted to glass by rendering it translucent by a slight addition of arsenic or tin in the making, and by etching the surface in various ways, and such iridescent glasses are often found naturally as the result of decomposition, but this is merely a surface effect, and such specimens cannot be cut to advantage; moreover, they lack the beauty caused by the fire permeating the entire substance of the gem. The opal ranks with the diamond, therefore, in resisting attempts at artificial production, and is even superior to it in that it cannot be really successfully imitated.

I come finally to the pearl. This, of course, differs from all other precious stones in being entirely of organic origin. The peculiar lustre of the pearl, like the colour of the opal, is due rather to its structure than its composition. It is formed in the oyster by the deposition of successive layers of calcium carbonate round some central object, and consists of an innumerable number of thin overlapping laminæ of the crystalline variety of this substance known as aragonite. These layers being semi-transparent, the light falling on the surface is partially reflected from the surface and partially transmitted into the stone, where it suffers reflection from the surface of lower layers (Fig. 10).

To produce this complicated structure artificially is practically impossible, unless one can describe as an artificial pearl that formed by the oyster in response to the deliberate introduction of irritant foreign matter by human agency. But in this case, who shall decide where nature ends and human ingenuity begins? Perhaps the well-known Japanese pearl may be correctly described as artificial pearl, although the oyster has a great deal to do with it.

Such pearls are formed by introducing a mother-of-pearl shape between the shell and mantle of the oyster and then leaving the oyster alone for a time to allow it to convert this into a pearl by the deposition of several layers of nacre. The mass is then removed from the shell and converted into the semblance of a true pearl by supplying a back of mother-of-pearl. Such pearls, however, never have the fine orient of those produced under normal conditions, and they can readily be detected by examining the back, when the lustreless mother-of-pearl and the line of junction can be detected.

Of course, wonderful imitations of pearl are made in various ways, which are difficult to distinguish from the natural article by casual examination. One method of preparation is as follows:—Small hollow spheres are blown in opalescent glass, coated inside with a preparation of fish scales, and then filled up solid with wax. Such imitations are identified by examination of the hole or by putting a spot of ink on

Fig. 10.

Section of Pearl, × 50.

the surface, when the reflection from the inner surface of the glass is seen. These empirical tests are usually sufficient, and it is rarely necessary to resort to testing the specific gravity and hardness, which provide further means of identification. It is worthy of note, however, that such imitation pearls are unique amongst imitation gems in that, in some respects, they are actually superior to the natural article. They are considerably harder for instance, and their lustre is not affected by constant wear.

In conclusion, I would like to refer very briefly to the present position of gems from the economic point of view. It is, perhaps, natural that the considerable influx of artificial gems in recent years, more particularly of the corundum species, has led to a great deal of controversy and difference of opinion as regards their merits. On the one hand the vendors of the artificial stones often publish extravagant

statements as to their defying identification, which, as I have shown you, is all nonsense. On the other hand, those interested in maintaining the prestige of the natural article make equally unreasonable statements, to the effect that such artificial productions, to quote a recently published circular, "are as worthless as the jewellery from a Christmas cracker." I have, I hope, clearly shown you the immense difference that exists between the imitation and the artificial ruby, taking an example; the former, it is true, depreciates rapidly in use, and deserves such a description, but the latter has absolutely all the essential qualities of the natural stone, and to place the two on the same plane as worthless trash is unfair to modern science and ingenuity. It must be clearly understood that there is no essential difference discernible between natural and artificial ruby as regards their beauty and their durability, which, as we have seen, are the two great items in the intrinsic value of a stone. But, of course, the price of a stone is chiefly determined by that third factor, which I have not so far taken into account—namely, rarity. Personally, I must confess that I have never been able to see why one should value a thing for no other reason than that it is difficult to get, although I suppose here I am in a hopeless minority, and that it is and always will be human nature to take this view.

It would serve no useful purpose to enter into that fruitful subject of controversy, the price of an article due to extrinsic causes, but I may say this—that whilst to me personally one is as good as the other, if any man is prepared to pay £100 for a natural stone when he can obtain essentially the same thing, artificially produced, for five, he is absolutely entitled to get it; and I would not wish you to think that I would defend for a moment the man who attempted to supply artificial as natural. But if this is so, it is still more the case that nobody has any right to supply anyone with paste under the name of artificial (or synthetic, or scientific, if these names are preferred) gem. I do think that the distinction between the two should be clearly recognised, and that it should not be permitted to use the term artificial indiscriminately. At present this is being widely practised; every day one sees offered for sale "rubies, emeralds, sapphires, and pearls artificially produced and having all the properties of the natural stone." Now, as I have indicated, such a thing as an artificial emerald answering this description is unknown, and, as a matter of fact, the stones supplied under this title are, as a rule, nothing more nor less than paste imitations, the public being deliberately led to believe otherwise. There is in this case, as I have indicated, a real practical difference between the two articles, not merely a question of opinion.

Again, one must deprecate the custom that has sprung up of arguing that, because "a rose by any other name will smell as sweet," a "scientific" stone will be as good by any other name than its right one. When synthetic yellow sapphire is called "scientific topaz," perhaps no serious fraud is perpetrated, although it is misleading, but when artificial white sapphire is openly and deliberately sold at a fancy price as "synthetic diamond," with the support of the press, I for one consider that matters are going too far, and that this is being done at the present moment anyone can verify for himself. All these misrepresentations may bring wealth to individuals, but they tend to bring into disrepute the artificially-produced gem, and instead of allowing it a place of its own as a distinct achievement, cause it to be looked upon as a spurious make-believe.

However, I did not come here for the purpose of discussing this aspect, and I will not dwell upon it further. I have, as far as possible, given you a *résumé* of the whole subject, and I will detain you no longer, except, if I may add one more word, to acknowledge the fact that my ability to bring this paper before you is very largely due to the assistance I have received in many quarters, and more particularly from Mr. E. Hopkins, whose enthusiasm on the subject of the technology of precious stones is only exceeded by his knowledge and experience. I am indebted to him, not only for much advice and information, but also for the loan of the specimens from which I have prepared the illustrations to this paper.

DISCUSSION.

The Chairman, in opening the discussion, expressed his great pleasure at having heard such an admirably clear paper, many of the points in which were new to him. It was the first simple account he had heard of the production of synthetic stones, and his first opportunity of witnessing such interesting and clearly intelligible pictures. Those towards the end of the lecture showed well the differences between the reconstructed and the natural stones, and those slides appealed more eloquently to an audience than any amount of written description. They were practically seen by the audience under the microscope. Mr. Heaton had reminded him (the speaker) of the occasion when he lectured before the Society

fifteen years ago, and it was a satisfaction to him that he had, at that date, been able to call attention to all the methods which had been mentioned that evening, even including X-rays, which had then just become available. He also said at the same date that he thought the time could not be far distant when sapphires could be produced as easily and perfectly as rubies were then beginning to be made. The difficulty seemed to be the reproduction of the peculiar blue colour. He also mentioned in his own lectures the refractometer, the simplest and most effective way of testing a stone by its refractive power. At the time it was a scientific instrument available only to the expert scientist; but Dr. Herbert Smith, with the aid of Mr. Steward, had now constructed an apparatus which was within the reach of any worker, and enabled him to determine, without special knowledge, the refractive index of a stone to a great degree of accuracy. If that were combined with the use of a heavy liquid for determining the specific gravity, it constituted an almost unerring means of determining whether the stone were natural or artificial. When, fifteen years ago, he spoke on the natural and artificial or reconstructed ruby being distinguishable by the air bubbles in the latter, he was only basing his remarks on a limited experience. He was glad to find that, despite all the efforts which had been made to approximate the artificial to the natural stone, that still remained an unfailing distinction. The question was a very interesting one, because of the light it might throw on the manner of production of the precious stones in the earth's crust. For instance, the description of the production of the diamond naturally bore a close resemblance to the manner of creation of the diamond in the masses of meteoric iron which fell from the sky. The research which had been devoted to the production of stones artificially, had pointed out the possibility of adding to the repertoire, for a beautiful series could be produced of which there were no parallels in Nature. Robert Boyle, in 1665, seemed to have been the first person to make scientific experiments on the distinction between artificial and natural precious stones, and he pointed out how important it was to use methods which did not destroy the stones; and for this, among other reasons, recommended the specific gravity as the test. He (the speaker) did not know why paste should be condemned because it was paste, so long as its true nature were known to the purchaser. He had long admired the charm of the Roman gems in the British Museum, and was interested to hear that they probably originated in Nubia. He had never seen anything which illustrated so clearly the reconstruction of rubies as Mr. Heaton's demonstration. He had imagined that the pedestal on which the material was fused was kept in rotation; he did not know whether that was no longer so. The lecture was not one of those which ended merely in talk; it was a scientific and expert exposition, and he hoped to hear criticisms and enquiries from those present, who might include many with practical experience of precious stones.

Mr. J. H. Steward declared that he had no expert knowledge of precious stones, but he had found the paper extremely interesting. His experience had been more in connection with instruments. Fifteen years ago he was present at the lectures given there by the Chairman, and he was much struck by the description of the refractometer, and he thought it would be a very useful instrument if it were further developed. Without knowing very much about it, he took it in hand, but was not quite so successful as he had hoped to be. But Dr. Herbert Smith, of the British Museum, happened to know that he was experimenting with it, and offered his assistance. With that assistance an instrument was evolved of great practical utility, not only for gem determinations, but in other industrial matters. Much gratitude was due to Dr. Herbert Smith for the care which he had bestowed on the improvement of the instrument.

Mr. E. Hopkins thought rarity had a great influence on the value assigned to stones, as in other matters, such as old books, china, furniture, etc. Other articles were quite as useful and valuable intrinsically, but rarity greatly enhanced the market price. Within the last three months two rubies had been sold in London for £1,200, notwithstanding the energy bestowed on the manufactured article. Although the pearl was a softer material than its artificial substitute, the price of that also had risen 50 per cent., and was still rising. Recently a law had become operative in Paris that all manufactured gems must bear the prefix "imitation"; the term "synthetic" was not deemed sufficient. That was, perhaps, carrying the matter rather far, but the energy at the back of the artificial article seemed to have made such a law necessary. White sapphires had been sold as diamonds, and, instead of 4*s*. or 5*s*. per carat, they had realised £5 per carat. One of the best safeguards was to require a detailed invoice with such purchases, as a precaution, especially as the prices differed so greatly, and so much fraud was being perpetrated in such matters.

Mr. B. J. Tully remarked that the slide of the ruby selected for showing on the screen had the structure technically known as "silk"; but such marking was not always present, and it was scarcely a typical test of the true ruby, though where a white sheen was seen on a specimen, it was a certain identification. The microscope was the only real test left, but it was unsatisfactory, as it could be used only for very thin and small specimens. The difficulty of making the sapphire originally was concerned with the colour; cobalt was used, and only by analysis of the real stone was cromium discovered as a constituent. The pretty slide of a pearl which was shown was that of a Scotch specimen; and it was the prismatic structure

in the centre which gave rise to the dull lustreless sheen. It was scarcely a typical specimen of Oriental pearl; the latter could not be ground down thin enough to form a microscopic section; it had a laminated structure, and would split into pieces in grinding. The beautiful slides shown were due to Mr. Heaton's ingenuity. Artificial stones seemed to have reached their zenith, and he hoped they would as quickly decline again. It was gratifying to know that natural stones were now increasing in price more than even they did when artificial stones were not in competition with them, and there was a greater demand for them. The action of one or two societies, and the exposures of fraudulent sales, would do much to reduce the number of artificial stones being worn.

Mr. Frank Stevens pleaded for greater accuracy of definition in the matter of precious stones and gems. Nowadays it was the custom to include among precious stones such things as pearls, which were an animal product, not mineral. He thought a gem should be held to be an engraved mineral, as distinguished from a precious stone which had been cut and facetted by the lapidary. He asked as to the possibility of procuring a synthetic jargoon by fusion of zirconium silicate in the blowpipe, so as to bring about the range of colour from deep orange-brown to apple-green.

Mr. W. S. Lockhart said that as he understood artificial gems always had air included in them, that would surely make a difference in their specific gravity. He had usually found that the smallest error due to this was apparent.

Mr. Heaton, in reply, said the Chairman's remarks were of great interest to him. He had not properly appreciated the work of Boyle on the specific gravity as a means of identifying precious stones. There was a legitimate place for paste for those who did not want to pay for real stones, so long as they understood what it was they were buying or wearing. The pastes mentioned by the Chairman came from Rome, but they were later than the Nubian ones. He shortened his historical account in order to spend more time on the practical side; the early history provided enough material for a lecture by itself. It was true that the revolving pedestal was used in the old apparatus for reconstructing rubies, but it was not necessary in Verneuil's ingenious process. Scientific tests gave much more than a mere opinion; they were always right, and often contradicted an expert opinion. That was most important in view of the skill of some of the imitators. With regard to the silky look, he took extreme examples in each case. It was very exceptional to find a natural ruby which had not some traces of the parallel structure or of inclusions. He did not agree with Mr. Tully that the microscope was not of much use; one could focus it to the centre of the stone, and by immersing the latter in a highly-refracting liquid one could examine the minutest detail of structure, and his own experience was that microscopic examination was of the greatest value. The pearl shown was not an Oriental one, because it was impossible to prepare a decent microscopical section of a proper Oriental pearl. With regard to the synthetical jargoon, the difficulty with all the silicate group was that one could not produce it artificially by the Verneuil process, because it would not then be crystalline but amorphous. Synthetic jargoon had been produced on a small scale by the process of crystallising out with a solvent, but it was not a commercial proposition to make the stones in that way. Zircon was not a very valuable precious stone; if it were rare it would be a serious competitor to the diamond; it had a high refractive index, and its optical properties were very good. With regard to alterations of specific gravity caused by inclusion of air, those could of course be detected if sufficient refinement of method could be achieved. But in the great majority of cases the alteration thus introduced would not be greater than those occurring in the natural stone through slight variations of composition.

On the motion of the Chairman, a vote of thanks was accorded to Mr. Heaton for his paper, and the meeting terminated.

THE LÖTSCHBERG TUNNEL.

The successful piercing of the lofty mountain range which lies to the south-west of the Jungfrau, and separates the Bernese Oberland from the Canton of Valais, is certainly a triumph of Swiss engineering skill and enterprise. It has broken the record in rock boring. The Lötschberg tunnel on the Berne, Lötschberg and Simplon Railway, now in construction, is designed to connect the network of northern Switzerland with the Italian lines. It will, when completed, form one of the principal approaches to the Simplon tunnel, and shorten the distance between Calais and Milan, *viâ* Bâle and Berne, by about fifty-three miles, reducing the time required for the journey by at least three hours.

On the north side, the new line starts from the station of Frutigen (Berne), and, following the course of the Kander River, will enter the tunnel at Kandersteg. From the southern end at Goppenstein, the line winds along the steep mountain-side of the Lötsch-Thal, passing through no fewer than twenty-one tunnels and over ten important viaducts, reaching the Rhône valley near Gompel, and, following the course of the river, will join the Simplon railway near Brigue. The works of this line are being carried out by the "Entreprise générale du chemin de fer des Alpes Bernoises."

The Lötschberg tunnel was commenced on October 16th, 1906, and is 14,535 metres 41 centi-

metres in length (9 English miles). The junction of the two headings was made on March 31st last, and so accurately had the work been planned and carried out by the engineers in charge, that the deviation in the line of the tunnel was found to be only 257 millimetres (10·12 inches); the difference in the levels 102 millimetres (4 inches); whilst the length was found to be 41 centimetres (16·14 inches) shorter. The piercing of the mountain has occupied exactly 53½ months. Its construction has been attended with many difficulties.

Of the four great Alpine tunnels, the Lötschberg will, when completed, be the third as regards length, the longest being that of the Simplon, which is 9¼ miles, and occupied about eight years in construction; it was opened in 1905.

The St. Gothard tunnel, opened in 1880, the second in length, is 14,920 metres (9¼ miles) in length, and occupied 111 months in construction; whilst the first of the great Alpine tunnels, opened about forty years ago, is 12,133 metres (7½ miles) long.

The average length of heading driven from both sides daily was 12·46 metres (40·35 feet). The daily average on the north side, for which the Meyer rock-boring machinery was used, was 7·84 metres (25·72 feet), whilst the progress made on the south side, where the boring was done by the Ingersoll drills, averaged 5·12 metres (16·8 feet). On the north side, the greatest distance tunnelled in a single day was 13·20 metres (43·3 feet) in the limestone, and 10·60 metres (34·77 feet) in the granite. The average length driven per month was 310 metres (1,017 feet) in limestone, and 261·80 metres (858·92 feet) in granite. The daily average for the same period was 10·69 metres (35·07 feet) in limestone, and 8·95 metres (29·36 feet) in granite.

EMPIRE NOTES.

British Trade with Canada.—A Blue Book has just been issued by the Board of Trade embodying a report by H.M. Trade Commissioner for the Dominion of Canada. The report presents a general survey of the prevailing conditions in Canadian markets, and also gives a number of tables and figures indicating the expansion of Canada's trade, and describes the business methods of the representatives of the different nationalities competing for a share in the industrial and commercial development of the Dominion. A section of the report provides an analysis of the import trade of Canada, making special reference to the relations of American and British producers to the Dominion market. The Commissioner points out that there is a keen and unremitting struggle going forward along the whole line of British and American competitors for the trade of that country. The United States, of course, possesses an advantage from its geographical position, and the close social intercourse existing between a large section of its people and those of Canada, and also from the cheapness of communication. On the other hand, Great Britain profits by the preferential customs granted thirteen years ago, and by the long-standing connection between the British producer and the Canadian consumer, and by the high reputation for excellence of quality and workmanship and businesslike dealings which have given her pre-eminence in the markets of the world. While it may be said that British trade with Canada, in manufactured goods, is holding its own with America, it is pointed out that there are some trades which are not doing so. The reason for this is not attributed to the lack of quality in British goods, but in the failure to adapt them specially to the Canadian market. The Commissioner points out that in respect to capital, the investment of American money in British Columbia is noticeably large, and at least half of the capital employed in the mines of that province comes from the United States. Against this there is to be placed the large influx of British capital, which is widespread throughout the Dominion. Many instances are also given in which British goods are more than holding their own, and the report shows that if up-to-date methods of fostering trade are adopted by British manufacturers they need not fear any competitors.

British Trade with Australia.—Mr. C. Hamilton Wickes, H.M. Trade Commissioner for Australia, when interviewed recently, gave some interesting particulars of British trade with Australia. He stated that the imports into Australia of goods from all countries in 1908 totalled £49,799,273; in 1909, £51,171,896; and in 1910, £59,456,238. The goods of British origin in 1908 amounted to £25,274,661 or 50·76; in 1909, £25,862,618 or 50·54; and in 1910, £29,877,209 or 50·25. "That shows," he said, "that the increase in 1910 was £4,014,591, which is enormous. The trade of our two chief competitors in 1909 is represented by a total of imports from the German Empire of £4,538,612, and from the United States of £5,935,740. The increase of goods of British origin in 1910 was therefore, in round figures, within half a million of the total German imports into Australia for the previous year. Apparently Great Britain shows a decrease of the total imports, but in this total of imports by the Commonwealth are included such items as timber, kerosene oil, rubber, raw tobacco, tea, coffee, cocoa beans, fresh fruit, fresh vegetables, fresh fish, and rice, articles which England does not and could not produce, and never will produce. When you come to examine what the trade of Great Britain is, and the percentage of British trade with Australia, deducting these items, you will find that the British share has increased over 63 per cent., and instead of showing a decrease over 1908–9 it shows an increase."

Oil Fuel for the Australian Navy.—The scheme of Australian defence recently promulgated by Admiral Sir Reginald Henderson, will involve the

Commonwealth Government in the expenditure of a large sum of money annually for maintenance, in addition to its initial cost. To meet the necessary outlay, which the Government are quite ready to do, the question of the relation of the scheme to the trade and industry of the country is one of importance. It is interesting, therefore, to note that a contract is being placed with the Commonwealth Oil Corporation for the supply of oil fuel for the navy. Discussing this matter in the House of Representatives, the Hon. G. F. Pearce, Minister of Defence, who has recently made a thorough inspection of the works of the Corporation, said:—"I am thoroughly satisfied, from the businesslike preparation they are making, and the extent of the works, that there can be no doubt that in a short while they will be able adequately to supply all our requirements in the way of oil fuel for defence purposes. No one could go through the trip I have just accomplished without being impressed with the value of the industry to Australia from a commercial point of view. I think very few people realise the value of the shale-oil industry, or what its possibilities are." It is estimated that the oil industry will find employment for many thousands of workers.

Trade, Commerce, and Mining in Rhodesia.—Satisfaction is being expressed everywhere throughout Rhodesia at the excellent position which is revealed by the official figures for Rhodesian trade for 1910. The imports by Southern Rhodesia of United South Africa products amounted to £467,907, against £438,660 in 1909, and of £2,318,414 other than South African products, as against £1,775,345 in the previous year. Of the latter, 64 per cent. was imported from the United Kingdom, 4·1 per cent. from other parts of the British Empire, and 31 per cent. from foreign countries. The value of the exports of Southern Rhodesia for 1909 was £2,801,811, and for 1910, £2,797,906; the value of goods re-exported for 1910 bringing the total to £3,199,956. North-western Rhodesia also shows an appreciable increase on 1909, and the mining industry of Rhodesia is in a similarly satisfactory condition. At the annual meting of the Chamber of Commerce, the President stated that if the requirements for labour were satisfied, there would in five years' time be 80,000 natives employed in Rhodesian mines against 30,000 at present. Two new companies were registered in Southern Rhodesia during 1910, the nominal capital of which is about one million and a quarter. The dividends of the various mining companies amounted in 1910 to £905,999, as against £481,000 in 1909. The value of the output from small gold claims registered in 1910 was £76,687, or over £46,000 more than in the previous year. Capital is being found for development work in the mines which, at depth, are proved to possess permanent and continuous ore bodies.

Indian Industries.—A novel industry appears to be on the eve of development in India, where oil of good quality is being produced in considerable quantities from boiled sardines on the west coast of Madras. It is asserted that it is suitable for the jute, leather, and steel (tempering) trades, and for many other operations. The oil is said to contain a large amount of fish tallow (stearine). According to the Director-General of Commercial Intelligence at Calcutta, one of the most important industries of the country, that of wood-pulp, is showing marked signs of progress. Eight paper-mills are in operation, whilst others are approaching completion. The value of the output for 1909 amounted to £516,666, which is the highest on record. The wheat export from the Bombay Presidency was on an exceptional scale during the season 1909-10, the shipments being the largest for many years past. On the other hand, there has been considerable depression in the cotton and spinning industry, owing largely to the high prices ruling for raw material, and in part to the competition of imported goods, which was an adverse factor of some moment.

HOME INDUSTRIES.

Unemployment Insurance.—The Chancellor of the Exchequer's scheme of social insurance will shortly be unfolded, and although some of its main provisions are known, its full presentment is awaited with very deep interest. It is to cover sickness and invalidity completely, and it is said that it will touch unemployment. German pioneer work will help the Chancellor in his attempt to solve the problems of maintenance during sickness and infirmity, and the German system of joint contributions from the employer, the employed, and the State, is to be followed. But formidable as are the difficulties to be faced in the endeavour to create a satisfactory system under these two heads of insurance, they are much less so than those which will confront the Chancellor if he attempts to legislate for insurance against unemployment. Irregularity of employment is the most pressing evil of the present industrial system, and is clamant for a remedy. The unemployed may be divided into (*a*) those who cannot work owing to age or ill-health; (*b*) those who are incompetent owing to habits; (*c*) those who are able and willing to work but are unemployed from lack of demand. Class I. will be covered by sickness and invalidity benefits and old-age pensions; class II. need punishment rather than help; it is class III. with which unemployment insurance must be mainly concerned. There are no statistics available on which to found a rigidly accurate actuarial scheme, and even if they were available they would not necessarily form a trustworthy basis for the future. Taxation, emigration, increase of population, improvement in machinery and methods of working, relations with the colonies and other countries, all these and many other considerations must have their bearing upon the result of any possible legislation. It is safe to say that no system of unemployment insurance can either

be a preventive or a cure of the evil, but a well-devised scheme that will help the needy and worthy workman in the days of unemployment is not perhaps too much to hope for. But it is difficult to see how this gigantic subject can be satisfactorily dealt with by Parliament whilst it is in the throes of a great constitutional struggle. And better no legislation on such a subject than any which has not been thoroughly thought out and fully discussed.

The New Mines Bill.—The Coal Mines Bill has now entered upon the Committee stage, after being the subject of separate and joint conferences of the coalowners and miners. There will be keen fighting in Committee over several of the clauses. One of the stiffest fights is likely to be on Clause 60, which imposes restrictions on the use of electricity in mines. The opponents of the use of electricity in the coal-mining industry are to be found on both sides, some colliery owners and managers being as keenly opposed as are some of the men. In certain mines there is practically a complete absence of inflammable gas in the airways and working places, and here electricity has been accepted by managers and workmen, but the West Stanley disaster in Durham, and the explosion at the Hulton Colliery in Lancashire, have deepened the distrust of the workmen as to the safe use of electricity in mines. Clause 60 authorises the inspector of the district to enforce the withdrawal of an existing supply of electricity from any mine, subject only to an appeal to arbitration, but this does not satisfy the opponents of electricity, who want to see it withdrawn from all mines. Another clause, of much less real importance, is likely to be the subject of hot debate, namely, that which makes compulsory the provision of bathing accommodation at all collieries. The colliery baths in Germany have proved a distinct gain to the miner, but the colliery owners contend that the obligatory use of the bath by every workman before he leaves the colliery will be an endless source of irritation between the management and the men. The younger men may be willing to adapt themselves to the new conditions, but it is pretty safe to say that they will be resented and resisted by many of the older miners.

Electricity and Colliery Accidents.—In connection with electricity in mines a paper written by Mr. Robert Nelson, H.M. Inspector of Mines, appears very opportunely. Mr. Nelson reviews the accidents and deaths due to electrical causes recorded during the six years ending December 31st, 1910. These he divides into three divisions, (1) ignitions of firedamp, (2) underground fires, and (3) electric shock. There were five fatal ignitions of firedamp, giving rise to thirteen deaths; and in each case it appeared that the presence of gas was unsuspected. Two fatal underground fires and two deaths were recorded. In each case the insulation of the cable and the presence of woodwork aggravated the fire. One fire arose from the sparking of a continuous-current motor, and the other probably originated in the oil-switch of a three-phase motor. Electric shock was responsible for fifty-three accidents and fifty-five deaths, thus greatly outnumbering other electrically-caused accidents. Of the accidents, twenty-two were due to defective or non-existent earthing of electrical cables and apparatus, twenty were due to defective insulation of cables, nine to contact with uninsulated parts, and two to other causes. Of the twenty-four accidents on cables, twenty occurred on unarmoured cables, thus showing the urgent necessity for enclosing all cables and, as far as possible, all other underground electric plant in efficiently earthed armouring. As regards the influence of current, thirty-three out of the fifty-three accidents occurred on three-phase systems and twenty on continuous current. It would seem that proper protective methods may be relied upon to eliminate most of the dangers arising out of electricity in mines.

The Break-up of Estates.—Whatever may be the explanation—and authorities differ as to it—there is a tendency just now on the part of great owners to sell portions of their estates. Not long ago it was announced that Mr. Walter Long, whose family has been established in Wiltshire for several centuries, had decided to sell something like half his Wiltshire estates. Since then many other considerable landowners, notably Lord Onslow, have followed suit, and now it is announced that the Duke of Bedford is about to sell nearly the whole of his estates in Devonshire. It may be hoped that the tenants, or most of them, will be able to buy, since two-thirds of the purchase-money can remain on mortgage if desired. In Norfolk, an estate of 5,240 acres, of which more than 3,000 consist of agricultural land, is in the market; in Suffolk an estate of 6,000 acres is to be divided up and sold in lots; and in Shropshire a property of 3,500 acres will shortly be the subject of an auction. Lord Ilchester is getting rid of his estates in Hampshire and Wiltshire, and other landowners are mentioned as having the intention to sell very shortly. If these estates pass into the hands of competent and solvent occupiers the change may be welcomed. A single change of ownership would, more likely than not, be a disadvantage to the tenantry. The big landowners, whose families have been associated with the land for centuries, are usually generous landlords, the "new men," more frequently than not, are the contrary.

Bogus Banks.—A very much wanted Bill has been introduced in the House of Commons, having for its object the restriction of the use of the term "bank" to *bonâ fide* banks, undertakings of sufficient importance and stability to entitle them to use it. During recent years all kinds of commercial undertakings for lending and borrowing money have called themselves "banks." There

have been "loan and discount banks," "land and investment banks," "building banks," "financial banks," and other variations. Some of these have been stable concerns, honourably conducted, but most of them have assumed the title of "bank" merely to obtain credit on insufficient capital. The public, more especially the working classes, usually ignorant in such matters, have been the chief sufferers. The difficulty is to define a "bank," and to distinguish between a *bonâ fide* bank and one not entitled to use the word. Major White's Bill provides that every person, not being a limited company, who commences to carry on the business of banking after the Act, shall deposit with the Board of Trade £20,000, to be invested in trust securities, and to be available for satisfying creditors. An annual balance-sheet, and profit and loss account, must be prepared, and every five years an independent investigation must be made for the Board of Trade into the financial condition of the concern. Whether the Bill would be adequate to accomplish its object, whether it might not encourage the public to assume the solvency of the concern to be guaranteed by the Government, when in fact it was not, are points upon which opinion will be divided, but whatever the merits of this particular Bill, its object cannot be too highly commended; and it ought not to be above the capacity of our legislators to stamp out the bogus "banks," which, by means of an honoured name to which they have no right, prey upon a credulous public.

Australian Shipping Laws.—It may be assumed that the Federal Ministers now on their way from Australia will be empowered and instructed to discuss with the Imperial Government the provisions of the Australian Navigation Bill. The protest made by the Liverpool Shipowners' Association has been seriously considered by the Federal Government, but it is not at present prepared to make all the concessions asked for. The principal clause objected to is 206, which enacts that "a steamship in respect of which a certificate of survey, granted or recognised by the Board of Trade of the United Kingdom, has been issued, shall, while that remains in force, be exempt from survey under this Act." The Board of Trade would like to see the exemption extended so as to cover all vessels holding Lloyd's or the International Registry's classification survey status, but the Australian Government are reluctant to concede this point.

OBITUARY.

James George Henry Glass, C.I.E. — Mr. J. G. H. Glass died at Naples on the 21st inst. Born at Braeadaile, Isle of Skye, in 1843, he entered the Indian Public Works Department in 1862, and was posted to the Central Provinces. In 1885 he was appointed Provincial Secretary of the Department, a post which he held for nine years in combination with the chief engineership. He was created a C.I.E. in 1890; four years later he was transferred to the United Provinces as chief engineer and secretary of the buildings and roads branch; and in 1896 he was again transferred to Bengal, where he acted in a similar capacity. He was a member of the Lieutenant-Governor's Council. He retired from the service in 1898, and on his return to this country he served on the board of visitors of Cooper's Hill Indian Engineering College until it ceased to exist.

Mr. Glass became a member of the Royal Society of Arts in 1900. He wrote a paper on "The Great Landslip at Gohna, in Garhwal, and the Measures adopted to Prevent serious Loss of Life," which was read before the Indian Section in 1896, during the author's absence in Bengal, where he was then Chief Engineer and Secretary of the Public Works Department. He received the Society's silver medal for the paper.

GENERAL NOTES.

The Turin International Exhibition, 1911.—Great activity is being displayed at the present time in every department of the exhibition at Turin in order to have all in readiness for the opening, which will take place on the 29th inst. The "International Exhibition of Industries and Work," as it is entitled, besides occupying the whole of the gardens of the Valentino Castle, on the left bank of the Po, extends for a distance of three kilometres (nearly two English miles) on both sides of the river, covering an area four times greater than that of the last exhibition, held in the same gardens in 1898. Here are situated the principal exhibition buildings, which comprise the gallery of machinery in motion, and that of electricity, together occupying an area of 60,000 square metres (14¾ acres). The galleries allotted to chemical and extractive industries, manufactures, silk, public works, railways, etc., cover about 70,000 square metres (17 acres). The British section occupies a prominent position in these gardens, covering an area of about 20,000 square metres (nearly five acres). The Hungarian section, which is also on the same side of the river, is considerably less in extent, occupying about two acres. Among the other many attractions on this side of the river may be mentioned the "Palace of Fashion," the palace of journalism, the exhibition of musical instruments, and the great Hall of Festivals. The buildings erected by the other nations are mostly on the right bank of the river, the space allotted to some of the principal countries being: France, 14,000 square metres (3 acres); Germany, 30,000 square metres (nearly 7½ acres); Belgium, 6,000 square metres (1½ acres); Russia and the United States, 8,000 square metres (about 2 acres) each, whilst the exhibits of the other nations are proportionately less extensive.

Altogether the total area covered by buildings is estimated at upwards of 400,000 square metres (about 100 acres). In addition to the two existing stone bridges over the Po, viz., the "Ponte Umberto I." and the "Ponte Isabella," communication between the two sides of the river is established by the fine monumental bridge, provided with a moving platform, above which is a second roadway. Two aerial transporters worked by electricity also cross the river, where an efficient service of motor-launches for conveying passengers is provided.

Export of Raw Silk from Japan.—The quantity of raw silk exported from Japan to Europe has increased steadily during the last five years. The following figures give the number of bales shipped from that country during the six months ending December 31st, 1910, as compared with those of similar periods of the previous years:—

	No. of bales exported to Europe.	America.	Total.
1906 . .	20,162	48,650	68,812
1907 . .	22,893	40,041	62,934
1908 . .	18,698	53,314	72,012
1909 . .	27,990	51,508	79,498
1910 . .	26,421	63,003	89,424

Opossum Farming in Australia.—On account of the recent rising market for opossum skins in Australia, chiefly because of their large export, especially to the United States, much attention is now being given to the possibility of breeding opossums for their fur in timbered parts of Australian farms. Several experiments of this kind have already been tried profitably. It is apparent that the future demands for Australian opossum skins can only be met by carefully breeding these animals commercially. An interesting suggestion in connection with the possibilities of opossum farming has been made by the Director of the Zoological Gardens at Sydney. He believes that every eucalyptus tree on Australian farms can be made productive by providing food for opossums, and that for every good-sized gum or eucalyptus tree the income of the farm might be increased by about two shillings. He is of opinion that a proportion of one male to three or four females would be an economical number to have, and that a simple method of keeping stock would be to place a number of small boxes, large enough to hold one opossum, in the trees and in an accessible position. The opossums would use these to sleep in during the daytime, when it is their habit to sleep, and the boxes would make it convenient to catch and examine them. The cultivation of maize and of chief fodder crops is also recommended in order to increase the opossum-carrying capacity of the farm and to enable the opossums to reach maturity more quickly. The chief food of the animals, however, is eucalyptus leaves, which in Australia, the native home of the eucalyptus tree, are naturally very abundant.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

May 3.—A. W. Gattie, "Improvements in the Transport and Distribution of Goods in London." James Swinburne, M.Inst.C.E., F.R.S., will preside.

May 10.—Hal Williams, M.I.Mech.E., M.I.E.E., "Beet Sugar Factories."

May 17.—Professor Raoul Pictet, "Les Basses Températures."

May 24.—Frank M. Andrews, "Architecture in America." Sir Aston Webb, C.B., R.A., F.R.I.B.A., will preside.

Indian Section.

Thursday afternoon, at 4.30 o'clock:—

May 25.—W. R. H. Merk, I.C.S., C.S.I., LL.D., "The N.W.F. Province of India."

Colonial Section.

Tuesday afternoon, at 4.30 o'clock:—

May 9.—F. Williams Taylor, "Canada and Canadian Banking." His Grace the Duke of Argyll, K.T., G.C.M.G., G.C.V.O., will preside.

Cantor Lectures.

Monday Evenings, at 8 o'clock:—

Alfred E. H. Tutton, M.A., D.Sc., F.R.S., "Rock Crystal: its Structure and Uses." Four Lectures.

Syllabus.

Lecture I.—May 1.—*The External Form of Rock Crystal and Chemical Character of its Substance.* Early Observations of its Geometrical Shape, and Conclusions drawn therefrom as to the Nature of Crystals in General—The Modern Conception of a Crystal—Measurement of the Angles between the Faces of a Quartz Crystal, and the Facts thereby Deduced—The Plan or Scheme of Arrangement of the Faces, and the Occurrence of Right and Left-handed Varieties of Quartz.

Lecture II.—May 8.—*The Internal Structure of Rock Crystal, and the Means we possess of Elucidating it.* The Chemical Molecules of Silica, and their Arrangement in a Space-lattice—The Influence of the Arrangement of the Elementary Atoms in the Molecule of Silica in Determining a Right or Left-handed Screw Structure—The probable Disposition of the Atoms and Molecules in the Right and Left Varieties of Quartz, and the Effect of this Internal Structure in determining the Outward Geometric Form—Revelation of the Oppositely Helical Structure by Etching and Liquid Cavities.

Lecture III.—May 15.—*Optical Evidence of the Two Complementarily Opposite (Mirror-image) Screw Structures.* Rotation of the Plane of Vibration of Polarized Light in Contrary Directions by the Two Varieties of Quartz—Experiments on the Artificial Reproduction of the Quartz Phenomena, in proof of the suggested Screw Structure—The Twinning of Quartz and Apparent

Enhancement of the Symmetry and Destruction or Modification of the Optical Activity thereby—The Interesting Case of Amethyst—The Magnificent Polarization Phenomena of Twinned Quartz.

LECTURE IV.—MAY 22.—*Scientific and Industrial Uses of Rock Crystal.* Its Thermal and Electric Properties, and its Transparency to Ultra-violet Rays—The Construction of Prisms and Lenses (including spectacles) of Rock Crystal, and their Advantages over Glass—The Use of Quartz for Balance Weights and in connection with the Interferometer—The Artistic Use of Quartz for the Carving of Vases and other Objects—Destruction of the Crystalline Structure by Fusion, and the Uses of Fused Silica in Fibres and Scientific Apparatus.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 1...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Dr. A. E. H. Tutton, "Rock Crystal—its Structure and Uses." (Lecture I.)

Farmers' Club, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. Mr. H. Trustram Eve, "Agricultural Land and Local Taxation."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 7.30 p.m. Mr. H. C. H. Shenton, "The Protection of Water-Supplies."

Chemical Industry (London Section), Burlington House, W., 8 p.m. Mr. C. Edward Sage, "The Testing of Creosote."

British Architects, 9, Conduit-street, W., 8 p.m Annual General Meeting.

Actuaries, Staples Inn Hall, Holborn, W.C., 5 p.m. Mr. T. Bradshaw, "Notes on the Insurance Act, 1910, Dominion of Canada."

Concrete Institute, International Building Trades Exhibition, Olympia, West Kensington, W., 5.45 p.m. Mr. R. W. Vawdrey, "Reinforced Concrete." (Lecture I.)

Economics and Political Science, London School of, Clare Market, Kingsway, W.C., 8 p.m. Mr. W. M. Geldart, "Legal Powers and Limitations of Trades Unions."

TUESDAY, MAY 2...Sociological, at the ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. George Paish, "Savings and the Social Welfare."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. E. C. Bodley, "The Decay of Idealism in France and of Tradition in England."

Alpine Club, 23, Savile-row, W., 8.30 p.m.

Economics and Political Science, London School of, Clare Market, Kingsway, W.C., 8 p.m. Mr. J. H. Morgan, "The Legal Liability of the Executive."

Faraday Society, at the Institution of Electrical Engineers, Victoria-embankment, W.C., 8 p.m. 1. Mr. A. Scott-Hansen (Christiania), "Hydro-Electric Plants in Norway and their Application to Electrochemical Industry." 2. Mr. Verdon Cutts, "Electro-Metallurgy in the Steel Foundry." 3. Mr. Edgar Stansfield, "Two Simple Forms of Gas-Pressure Regulators."

WEDNESDAY, MAY 3...ROYAL SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. A. W. Gattie, "Improvements in the Transport and Distribution of Goods in London."

Public Analysts, at the Chemical Society's Rooms, Burlington House, W., 8 p.m. 1. Messrs. J. C. Umney and C. T. Bennett, "The Evaluation of Certain Spices used in Medicine." 2. Mr. Edward Halliwell, "Absorption of Dissolved Oxygen by Sewage Effluents and the Royal Commission's Provisional Standard." 3. Dr. G. D. Lander and Mr. A. E. Walden, "The Detection of Traces of Hydrogen Cyanide." 4. Messrs. A. E. Parkes and J. D. Roberts, "Note on the Composition of 'Blaud's Pills'"; "Note on the 'Pearl Coating' of Pills." 5. Mr. J. F. H. Gilbard, "A reaction for 'Caulophyllin.'"

Royal Archæological, at the Society of Antiquaries, Burlington House, W., 4.30 p.m. Miss E. K. Prideaux, "The Sculptured Figures on the West Front of Exeter Cathedral Church."

Economics and Political Science, London School of, Clare Market, Kingsway, W.C., 5 p.m. Sir John Cockburn, "The Referendum in Australia."

Concrete Institute, 296, Vauxhall Bridge-road, S.W., 5.45 p.m. Mr. R. W. Vawdrey, "Reinforced Concrete." (Lecture II.)

THURSDAY, MAY 4...Antiquaries, Burlington House, W., 8.30 p.m.

Linnean, Burlington House, W., 8 p.m. 1. The Rev. T. R. R. Stebbing, "On John Vaughan Thompson and his Polyzoa, and on *Vaunthompsonia*, a genus of Sympoda." 2. Professor Sydney J. Hickson, "On *Polytrema* and some allied genera." 3. Mr. J. M. Brown, "Observations on some new and little-known British Rhizopods. 4. Mr. R. Shelford, "The British Museum collection of Blattidæ enclosed in Amber." 5. Dr. F. E. Fritsch, "Freshwater Algæ collected in the South Orkneys by Mr. R. N. R. Brown."

Chemical, Burlington House, W., 8.30 p.m. 1. Messrs. F. B. Power and C. W. Moore, "The Constituents of Bryony Root." 2. Messrs. H. Leete and E. de B. Parnett, "Note on the Action of Hydrogen Dioxide on Thiobenzanilide." 3. Mr. K. J. P. Orton, Miss M. G. Edwards, and Mr. H. King, "Purification of Acetic Acid." 4. Miss M. G. Edwards and Mr. K. J. P. Orton, "The Detection and Estimation of small quantities of Acetic Anhydride in Acetic Acid." 5. Messrs. P. C. Ray and H. K. Sen, "Tetramethylammonium Hyponitrite and its Decomposition under Heat." 6. Messrs. G. Senter and A. W. Porter, "Reactivity of the Halogens in Organic Compounds. Part VI. The Mechanism of Negative Catalysis." 7. Mr. E. B. R. Prideaux, "The Second and Third Dissociation Constants of Orthophosphoric Acid." 8. Messrs. F. B. Thole and J. F. Thorpe, "Experiments on Tautomerism. Part I. The Tautomerism of the System $X-CHR-CR=CR-X$, showing the identity of the α- and γ- Positions in the Glutaconic Acid Molecule."

Royal Institution, Albemarle-street, W., 3 p.m. (Tyndall Lecture.) Professor R. W. Wood, "The Optical Properties of Metallic Vapours." (Lecture II.)

Camera Club, 17, John-street, Adelphi, W.C., 8.30 p.m. Mr. C. E. Keyser, "Norman Dorways of Gloucestershire."

Philatelic, 4, Southampton-row, W.C., 6 p.m. Mr. T. W. Hall, "The Early Issues of Chili."

Roentgen Society, 19, Hanover-square, W., 8.15 p.m.

FRIDAY, MAY 5...Royal Institution, Albemarle-street W., 9 p.m. Professor Martin O. Forster, "New Organic Compounds of Nitrogen."

SATURDAY, MAY 6...Municipal and County Engineers (Eastern District Meeting), Guildhall, Cambridge, 11.30 a.m. 1. Mr. Julian Julian, "Cambridge from a Municipal Engineer's Standpoint." 2. Visits to Municipal Works, etc.

Royal Institution, Albemarle-street, W., 3 p.m. Professor Selwyn Image, "William Morris: or, the Craftsman and Art." (Lecture II.)

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Where no folio is given Advertisement does not appear in this issue.

All communications respecting Advertisements should be addressed to the Advertisement Manager, 5, Queen Victoria Street, London, E.C.

London: Printed by WILLIAM CLOWES AND SONS, LTD., Duke Street, Stamford Street, S.E., and published for the Royal Society of Arts by GEORGE BELL AND SONS, LTD., York House, Portugal Street, W.C., in the Parish of St. Clement Danes, in the City of Westminster.—April 28, 1911.

THE MURAL PAINTINGS OF KNOSSOS.

AN INVESTIGATION INTO THE METHOD OF THEIR PRODUCTION.

BY

NOEL HEATON,
B.Sc., F.C.S.

Reprinted from the "Journal of the Royal Society of Arts," January 7, 1910.

LONDON:
PRINTED BY WILLIAM TROUNCE, 10, GOUGH SQUARE, FLEET STREET, E.C.

1910.

THE MURAL PAINTINGS OF KNOSSOS.

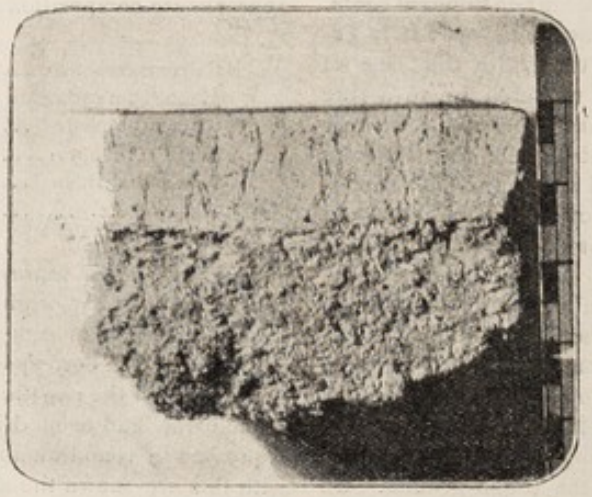
*An Investigation into the Method of their Production.**

By NOEL HEATON, B.Sc., F.C.S.

Through the kindness of Dr. Evans, I was recently enabled to make an investigation as to the materials employed in the production of the mural decorations of the Palace of Knossos, and to determine the process followed in their execution. Fourteen small fragments of the painted plaster came into my hands for the purpose, and a preliminary examination of these showed that they consisted of what is generally known as stucco duro, prepared from time immemorial by laying a smooth coat of fine lime plaster on the roughly rendered wall surface. In view of the established date of these paintings—about 1500 B.C.—it is probable that they represent some of the earliest examples of the use of this material in a fully developed state.

As the wall on which the paintings were to be executed was only of coarse rubble construction, in common, as I understand, with the majority of the internal walls of the palace, it formed itself the rough backing or priming coat on which the fine intonaco was laid. The whole construction was very well shown in one of the specimens, which, moreover, formed a suitable subject for experiment, being painted with merely a flat wash of colour of no particular interest, so that one had no scruples in sacrificing it. I therefore commenced my examination by cutting this fragment in half vertically by means of a fine saw, and grinding the section thus exposed to a flat surface by carefully rubbing it down on a slab of ground plate glass, finally treating it cautiously with dilute hydrochloric acid to remove the fine dust and show up the structure.

I obtained by this means a section through the stucco itself and part of the wall backing, from which a good idea could be obtained as to the thickness of the different layers. This section, photographed by oblique light in order to emphasise the structure, is shown in the illustration. It will be noticed that the rough rendering on which the stucco has been laid, and of which a thickness of 1½ inches is indicated by the scale on the right of the specimen, is of very irregular character—it is, in fact, a coarse mortar of rubble and lime, containing also a good deal of clay, and in all the specimens this backing is very friable and badly preserved. On submitting this portion to a mechanical separation, by carefully breaking it down under water, and washing out the finer particles by



* A Report presented to the Society of Painters in Tempera, March 8, 1900.

setting power and becomes friable on carbonation. The composition in this instance seems, however, at first sight, to point to the use of such a material, notwithstanding the remarkable hardness and stability of the plaster. But we must not lose sight of the possibility that this result may have been caused by the use of the material only partially caustic, that is to say, that the process adopted may have been to use, mixed with the caustic lime, a proportion of the same limestone from which the lime was prepared in its natural state, merely powdered, not burnt. This fact would not of course be revealed by analysis, any more than the presence of marble dust.

I made a series of experiments in the endeavour to throw some light on this point. If the method I have suggested had been adopted it would be extremely unlikely that the limestone would be powdered to such a degree of uniform fineness that fragments of it could not be isolated and recognised by microscopic examination. I therefore carried out the following experiments :—

1. Etching the surface of the plaster with very dilute hydrochloric acid, carefully watching the process of disintegration under the microscope.

2. Dissolving away the lime entirely from a fragment and examining the insoluble residue that remained. In every case this consisted of minute fragments of silica and iron oxide present in the limestone as impurities : the latter in every case were in the anhydrous condition as red ferric oxide, indicating that the lime containing them had been burnt. Had I discovered any fragments of hydrated yellow oxide, this would have pointed to the presence of unburnt material in the mixture.

3. Carefully powdering a fragment of plaster so as to separate the grains without breaking them up, the powder so obtained being submitted to a process of mechanical separation by means of a modified form of Schulze apparatus for the mechanical analysis of soils, the residue obtained after washing off the fine powder being microscopically examined and the specific gravity of the fine and coarse particles compared. The microscopic examination should reveal the presence of any fragments of broken limestone, which would have the shape characteristic of a comminuted material, whilst the specific gravity of fragments of natural limestone would be greater than that of carbonated free lime.

4. Making thin sections of the plaster in the manner usually adopted for the microscopic examination of rocks, and treating in a similar manner to the foregoing.

5. Extracting the powder prepared in the method described under 3 with carbon di-oxide under pressure. For this purpose I introduced a weighed quantity of the powder into a sparklet apparatus, which was then filled up with distilled water and aerated in the usual way, the powder being removed and examined after an exposure varying from a day to two months.

All the above experiments, many times repeated, failed to reveal the presence of any minute fragments of unburnt limestone.

The evidence thus afforded, however, being entirely negative, I do not regard it as conclusive. It would seem so improbable, in view of the unanimous opinion of those who have had practical experience of plaster, that pure lime could produce the magnificent stucco we have before us, that I prefer to keep an open mind on the question and regard the exact process employed as a matter for further discussion. I can only say that I have been unable to determine the use of any other material than caustic lime.

We now come to the question of the materials used as pigments. Five colours were recognisable in the fragments that came into my hands, viz., white, black, red, yellow and pale blue. Mr. Theodore Fyfe tells me that he distinguished several other colours in some of the frescoes, notably a deep blue and a rose red, but as these were not represented in my specimens I am unable to offer any opinion as to their nature. Of the five colours above enumerated the white, generally used as a wash over other colours or to provide dividing lines in relief, was composed of calcium carbonate, probably employed in the form of hydrate of lime, as used in modern and mediæval times. The black lost its colour on ignition with evolution of carbon dioxide, but suffered little diminution of weight, leaving a white residue, insoluble in acids, and containing a large proportion of silica. This indicates a material of the nature of a carbonaceous shale or slate, consisting of aluminium silicate (china clay), coloured with a small proportion of carbon. A material of this nature, known at the present time as black chalk, or Italian chalk, submitted to the same treatment, gave precisely similar results, and we know that such a substance was used for fresco painting in mediæval times from the writings of Cennini, who says (cap. 34):—"I have found that a

certain black stone brought from Piedmont is good for drawing; sharpened with a knife it is soft and very black, and as good as charcoal." (Similar references are found in many of the mediæval treatises on pigments).

The red and yellow pigments gave all the characteristic reactions for iron earths, the red turning black on ignition, and regaining its colour on cooling, and dissolving in hot strong hydrochloric acid, giving a yellow solution answering the recognised tests for iron; whilst the yellow, on ignition, was converted into a pigment similar to Venetian Red. These pigments may, therefore be considered as haematite and yellow ochre respectively. Sir Arthur H. Church, who examined some of the specimens of the Knossos frescoes some time since, tells me he came to the conclusion that both pigments were of the same material, the yellow in its natural state, and the red being calcined, but my results did not agree with this, the yellow giving a paler and more delicate red on ignition, and containing a lower percentage of iron oxide.

The blue is a magnificent pigment, being of a pale, but, at the same time, indescribably rich and pure tone. It is similar to the blue examined by Davy* on the Pompeian frescoes; the use of which continued down to mediæval times.† It is essentially a silicate of copper and soda—that is to say, a glass coloured by copper—and owes its peculiar texture to being in comparatively coarse powder. This would of necessity be the case, because if very finely powdered its blue colour would be almost entirely lost by the reflections of the light from the surface of the particle, giving an appearance of white, in the same way that snow or colourless glass gives a brilliant white powder when in a finely divided state. When viewed by oblique light, a surface painted with this pigment has a sparkling effect, due to the reflection of light from the broken surface of the glass, which enhances the beauty of the colour. The modern pigment, known as Egyptian blue, misses this quality entirely through being more strongly coloured and in a state of fine division.

Davy gives the following directions for making this pigment:—"I find that fifteen parts by weight of carbonate of soda, twenty parts of powdered opaque flint, and three parts of copper filings, strongly heated for two hours, gave a substance of exactly the same tint, and nearly the same degree of flexibility." I have not succeeded up to the present in producing precisely the same delicate quality of the Knossos blue by this method.

We come finally to the method of execution, which, as I have indicated, was one of true fresco. This is revealed unmistakably by the following facts:—

1. The pigments adhere firmly to the plaster and stand brushing over with a wet sponge and prolonged boiling in water without injury to the painting.

2. Prolonged treatment with pure ether and other solvents fails to extract any vehicle or medium. In one instance it is true that after warming a fragment of the painted surface with ether in a flask connected with a reflex condenser for two days, I obtained a minute quantity of residue which proved to be wax, but numerous repetitions of the experiment failed to duplicate the result. Mr. Fyfe tells us that in some instances broken fragments were cemented together by means of wax for examination, and it is probable that some of this wax may have been on the fragment which gave this exceptional result.

3. In many cases one can detect places where the surface of the wet plaster has been dragged up by the brush in laying on the pigments, the marks of the brush being clearly seen when the specimen is examined under a lens.

4. If a fragment of the painted surface be treated with dilute hydrochloric acid, it invariably disintegrates with effervescence, and eventually the pigment is left in a state of powder, proving that the particles were merely bound together with carbonate of lime.

Having watched the whole process of disintegration under the microscope repeatedly, the results are so consistent and characteristic as to leave no possible reason for doubt on this point. Taking these results as a whole, the fact that the paintings were executed in true fresco is so obvious as to need no further comment. It is also clear, as far as regards

* "Phil. Trans," 1815, pp. 97-124.

† By collating the various mediæval treatises on painting, it is evident that this pigment was known to Vitruvius as Cœruleum, and to later writers as Smaltino and Esmalte, and finally Smalt. It is not the same as our modern Smalt, however, which is a potash glass coloured with cobalt. This pigment was introduced in the fifteenth century, and gradually supplanted and took the name of the original Smalt, even as this, in its turn, has become at the present time practically obsolete through the introduction of the more reliable Cobalt Blue, which is not a vitreous pigment at all, but a compound of cobalt oxide and alumina. In a similar manner, the old name Cœruleum has, in our days, been reintroduced and applied to a pigment of modern introduction, similar to cobalt blue, but of different composition and colour.

the specimens actually examined, that the paintings were executed throughout in fresco, and were not begun in fresco and finished "a secco," a common practice in mediæval times, and one which, to my thinking, Vasari rightly condemns in the following words :—

"Many of our artists are very expert in other branches of the art, namely, in oil and distemper painting, but do not succeed in this, because it is indeed the most manly, the most certain, and the most durable of methods, and by age it continually acquires beauty and harmony in an infinitely greater degree than any of the others. This kind of painting cleans itself in the air, is proof against water, and always resists any blow. But it is necessary to take care not to retouch the painting with parchment glue, yolk of egg, or gum, as many painters do ; because, while the painting fails to acquire its usual brightness, the colours become tarnished by this, and, therefore, let all those who wish to paint upon walls paint in fresco like men, without retouching in secco, which, besides being a most vile practice, shortens the duration of the pictures."*

The examination of a few small fragments is not sufficient, however, to warrant one in asserting that retouching in secco or tempera was never practised, a careful examination of the actual specimens being necessary to decide this point finally ; from the fact that we hear of the occasional discovery of specimens showing one painting superimposed on another, it seems likely that this method was sometimes adopted, but I think it is evident that the general process employed was to put in both ground and detail in fresco, a flat wash being laid on first, immediately followed by the detail. Pigments are often found superimposed, in the specimen I have examined, but in every case they flow one into the other and are intimately combined by the carbonate of lime which alone holds them to the surface, showing that the ground was wet and caustic when the second coat was applied.

It would be interesting, in this connection, to know the speed at which the work was executed, and how much ground was covered in the "tarea" or day's work ; it is possible that this could be ascertained by a careful study of the paintings, as it would need extraordinary skill on the part of the artist to make the joinings of the "tareas" so perfect as to defy close examination, although, of course, burial for so many centuries may have modified the surface to such an extent as to have obliterated any evidence of the junctions.

* "Introduction to the Three Arts of Design." Trans : by Merrifield in "Art of Fresco Painting," p. 31.

Speaking of the manner in which the pigments adhere to the surface, I was surprised to find to what an extent they actually penetrate into the surface of the plaster in many cases ; when I was preparing the specimens of the intonaco for analysis I found, in fact, some little difficulty in freeing the upper surface from the pigment. In his notes to the recently published "Vasari on Technique," Prof. Baldwin Brown says (p. 288) :—"It is a mistake to speak of the pigment sinking into the wet plaster. It remains on the surface, but it is fixed there by a sort of crystalline skin of calcium carbonate which has formed on the surface of the plaster." I certainly cannot endorse this view as far as the specimens under consideration are concerned ; on the contrary there was, as I have stated, a considerable amount of penetration of the pigment into the ground so that the two were very intimately united.

I have set forth at some length the facts which I have been able to ascertain concerning these paintings, and have gone into details which may seem to some elementary, and of trifling importance, in the endeavour to present an impartial record of facts as I have found them, and because it always seems to me desirable to give as fully as possible the means by which one has arrived at any conclusion, in order that its correctness may be open to discussion. Only too often one hears categorical statements concerning the methods of execution of paintings, &c., in ancient times, and seeks in vain for the facts on which the statements are based, so that one can use them as a guide for further work.

Perhaps the point of most general interest in connection with these paintings is the very perfect state of preservation in which they have come down to us, for it must be remembered that they were not executed in tombs—as was the case with many of the Egyptian examples —and sealed up at all times from the effects of both light and atmospheric influence, besides being preserved from anything in the shape of wear and tear; they were placed on the walls of a royal palace, in many cases forming the decorations of the main corridors which would be subject to continual traffic whilst the palace was in occupation.

The permanent character of fresco decorations has been a matter of frequent discussion, and it is a question how far in this instance their preservation is due to their intrinsic merit and how far to accidental circumstances. It is one thing to last when buried in the earth

and another thing to be able to withstand exposure *in situ* for an indefinite period—which of the two conditions forms the severer trial depends on circumstances, on the character and dryness of the soil in which they are buried, and the purity of the atmosphere to which they would otherwise be exposed, for instance.

But one would very much like to know how long the frescoes of the palace of Knossos had been standing before they became involved in the general destruction of the Palace when it was sacked and pillaged, and their fragments were sealed up in the ruins to be revealed to us by the genius of Dr. Evans There is, however, evidence to warrant one in thinking that they had been on the walls for at least 100 years before this happened; moreover, I gather that the frescoes were treated after the manner of our wall hangings, and broken up and removed in order to be replaced by fresh designs in re-decorating the palace from time to time.

One can imagine, for example, that at the accession of a new ruler the interior decorations of the palace would be renewed, and that at such times the frescoes might be broken up without regard to their state of preservation. Fragments evidently broken up in this manner have been found with the painting still in a state of perfect preservation, which seems to point to the fact that the decorations were at all events sufficiently permanent when *in situ* to outlast the purpose for which they were intended.

Of course it does not follow from this, that even if one produced such decoration in every way identical with these they would last in a similar manner in this country at the present time, for although the natural climate to which they would be exposed differs but little—our humid and "muggy" winters are by no means unknown in Crete—it is pretty certain that they did not have to run the gauntlet of such conditions of contaminated atmosphere as are met with in a modern town.

The two great enemies to fresco in this country are humidity, and an atmosphere more or less acid by contamination with the products of combustion of coal. Humidity hinders the proper drying of the plaster and renders it liable to become intermittently damp; the result of this is that so long as any un-carbonated lime remains in the plaster any moisture present on the surface of the painting will dissolve some of the hydrate of lime, forming a film of lime water on the surface which will become carbonated on exposure to the air, depositing carbonate of lime over the painting, thus to a certain extent obscuring it with a white film. In this connection it is interesting to note that one can detect a minute quantity of free hydrate still present in these Knossos specimens, notwithstanding their 3,500 years of exposure, so that the conversion of the hydrate into carbonate would appear to be a much longer business than is generally supposed, and the phrase "so long as any un-carbonated lime remains" implies a good deal.

The trouble with our modern conveniences of warming and illumination provided by the use of coal as a fuel is that they result in the discharge of huge quantities of sulphur in the air in the form of sulphuric acid. This fact and its bearings on the decay of buildings, &c., is too well known to need enargement; but the effect of such an atmosphere on a surface of carbonate of lime formed by carbonation *in situ*, without even the compacting process to which natural limestones are subjected, is disastrous—the painting is slowly destroyed by the conversion of the carbonate of lime to sulphate.

This has been so well demonstrated that fresco painting has been under a cloud for some time, and many writers have proved to their own satisfaction, at any rate, that fresco in this country is inevitably doomed to be a failure.

But whilst clearly recognising these facts, and admitting that a surface of pure carbonate of lime such as that of the Knossos frescoes cannot, perhaps, be looked upon as permanent under modern conditions, I think that many of the troubles of which we have heard so much have been due to an imperfect understanding by artists of the reactions involved in the process. Neither do I consider that the last word has been said as to the possibility of so modifying the process as to overcome these difficulties whilst retaining the inimitable qualities which fresco offers to the painter, and obviating that necessity for after treatment which can only be looked upon as making the best of a bad job.

Of course, a great deal has been said and done in this direction — witness, for example, the stereochromy process and its modification known as "Keim's process" —but I think that more yet remains to be accomplished: the charm of a well-executed fresco is so great, it forms such a noble method of decorating our great buildings

for the delight of future generations, that no effort should be spared towards perfecting the process in order to assure the artist that sense of security in his work which the great labour and skill involved in its execution justly demand.

All the knowledge that we can glean of the methods and conditions of the old time painters can be of service to this end, and it is in the hope of being able to reveal some useful hint to modern workers that I have undertaken this inquiry into the method of execution of these old Minoan frescoes of close on four thousand years ago.

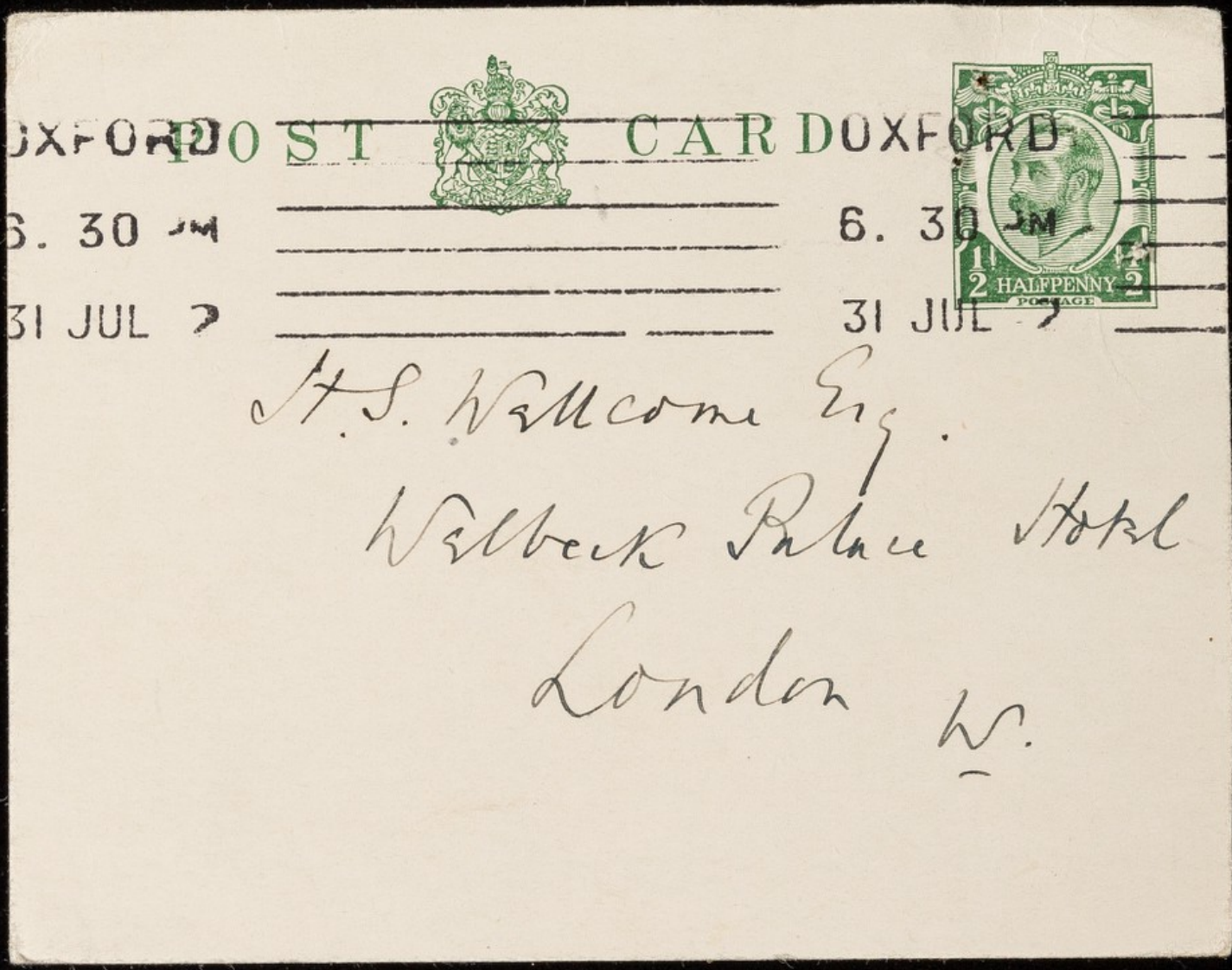
PRINTED BY WILLIAM TROUNCE, 10, GOUGH-SQUARE, FLEET-STREET, LONDON, E.C.

Magdalen Coll. Oxford

Very well - Thursday - I shall
hope to see at 3: but I must get
back to the region of Portman
Square by 5.

D G Hogarth

31. VII. 12.



H. S. Wellcome Esq.

Wellcome Physiological Research Laboratories

London W.

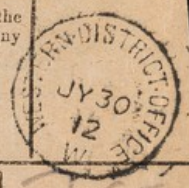
N.B.—This Form must accompany any inquiry respecting this Telegram.

POST OFFICE TELEGRAPHS.

EYRE & SPOTTISWOODE, Ltd., London.

If the Receiver of an Inland Telegram doubts its accuracy, he may have it repeated on payment of half the amount originally paid for its transmission, any fraction of 1d. less than ½d. being reckoned as ½d.; and if it be found that there was any inaccuracy, the amount paid for repetition will be refunded. Special conditions are applicable to the repetition of Foreign Telegrams.

Office Stamp.



Office of Origin and Service Instructions.

Oford B.

Charges to pay £. d.

Handed in at 7-30 P.M. Received here at 7.56 P.M.

TO Welcome Welbeck Palace Hotel

Dolphin. Can come meet me Thursday W. 3 o'clock. Could manage Thursday afternoon till five or Tuesday afternoon if know where and when Regards

11. Dec. 1912

Magdalen College,
Oxford.

Dear Sir

I cannot think of anyone offhand and I have not, so far, heard of a suitable man: but I will enquire in other quarters & if any name commends itself, I will suggest it to you at once.

Yours very truly

D. G. Hogarth

Xmas Day 1912

20, St Giles',
Oxford.

REPLY SENT.
27 DEC 1912

Dear Mr. Thompson

Re a man for your posting &c.
I cannot hear of anyone except,
perhaps, Mr. G. Evelyn White now
in Egypt (at Luxor) working for New
York, but, I know, not of a job
after this season. He would hardly
be available till April at the earliest.
He is a very fair archaeologist of
varied experience (e.g. twice Stein's
assistant at the Brit. Museum in
arranging C.A. finds &c.,
several seasons in Egypt, selected
Classicist in the Brit. School at
Athens dig last season, & visited the
Italian War fortifications). Fairly orig.

are more immediately available. You might do much worse than take Whitt. She lacks "go" somewhat - is inclined to discontent, but if he is methodical strong a good deal of industrious.

Yours very truly
D G Hogarth

Easley Mews

27th December 1912.

Dear Mr. Hogarth,

I desire to thank you for your kind letter of the 25th inst. and for the trouble you have been good enough to take respecting a suitable man for the Sudan archaeological objects. I will get in touch with Mr. Evelyn White on his return if I am unable to meet with a man before then. As Mr. Casson is leaving me next week for Athens I had hoped to have got someone to fill his place for the next six months, but so far have been unsuccessful.

Thanking you very cordially for the trouble you have taken in the matter, and wishing you the compliments of the season,

I am,

Faithfully yours,

C.J.S.T

Easley Mews.

29th November 1911.

Dear Sir,

In September last you replied to an advertisement I inserted in the Athenaeum for a gentleman for archaeological work, to arrange a collection for a museum.

If you are still disengaged, I should be glad to hear from you again. The nature of the work is as follows:- the classification and arrangement of a number of objects of the prehistoric and Stone periods, ancient pottery, etc. I wish to meet with a gentleman who has a sound knowledge of prehistoric archaeology, and who is able to identify and classify implements and pottery, etc., of various periods.

If you are qualified to do this, kindly let me know, and I could see you on Friday morning at 10.30 a.m., if you will call at the above address.

Faithfully yours,

C.J.S.T.

harles Gilbertson Esq.,
6 Elm Park Gardens, S.W.

Fri. 10.30

Will not call

46, ELM PARK GARDENS,
S.W.

M

11th Sept. 1911

Dear Sir

In reference to your notice in the current number of the Athenaeum perhaps you would be good enough to let me have particulars of the class of work, that is required, & also to what Museum your Advertisement refers

Yours truly

Charles Fullerton

M.A. Oxford

Easbey Mews.

29th November 1911.

Dear Sir,

A few months ago you wrote to me with respect to an advertisement I inserted in the Athenaeum for a gentleman with museum experience for archaeological work.

If you are still disengaged, I shall be glad if you could call and see me at the above address on Friday morning next, at ten o'clock.

Faithfully yours,

C.J.S.Thompson,
per

M. Temple Esq.,
181 Queens Gate, S.W.

30th November 1911.

Dear Sir,

In reply to yours of the 26th inst., I have noted your application for the post I have vacant. The work in hand at present is the classification and arrangement of a large collection of implements, pottery, etc., prehistoric and Stone Ages. As further excavations are made these will be increased, and the work is likely to go on for a considerable time.

There will not be any opportunity of participating in excavations at the present time, as the work to be done is of a different character.

If you are desirous of placing a serious application for the post, kindly let me have full particulars of what knowledge you have on the subject, and if it is considerable in the prehistoric and Stone Age periods.

The post is practically a permanent one, although on a month's notice on either side, for a suitable man, and the hours of work are from nine to six daily, and from nine to one on Saturdays.

Awaiting the favour of your reply,

I am,

Faithfully yours,

C.J.S.T.

Donald Atkinson Esq.,
The Grammar School,
Stamford.

The Grammar School
Stamford
26/11/11

My dear Sir

I have received from the Oxford Appointments Committee a notice respecting the post which you have vacant; and have ventured to write to you respecting it. I wish to remark that I have spent on an average six weeks during the last three years at the Excavations now in progress at Corbridge-on-Tyne, & have done a little excavating in Oxfordshire for Professor Haverfield. I mention this in order to show that I have had some experience of practical Archaeology, & that I am not actuated by mere curiosity in writing to you for a little further information concerning the post you wish to fill. I should like to know what duties would be attached to it

beyond the arrangement of the existing
Collection. Would there be any opportunity
of participating in excavations & are
Roman remains met with in the scope of the
position.

I trust that you will excuse the very
bold step I have taken in writing
to you in this way, but as I am
extremely anxious to engage in
archaeological work & at the same
time my circumstances are such
that some caution is essential in
making any change in my position
I have ventured to do so

I am

Yours very sincerely

Donald Atkinson B.A.

Please insert in Athenaeum, this week certain, in "Wanted" column:-

ARCHAEOLOGY. Gentleman, 25-35, as archaeological assistant, experienced in classifying and identifying objects of the prehistoric and Stone Age, and with good knowledge of ancient pottery. Must be thoroughly reliable and trustworthy. Write full particulars, age, experience, and salary required, to "Saville", C/o Coe's 4 Oxford Street, W.

Please ~~xi~~ insert in the "Wanted" column, to-morrow's ~~i~~ssue:-

A gentleman required with good knowledge of archaeology, especially prehistoric and Stone Age. With museum experience. Some knowledge of Egyptology desirable. Permanency. Write full particulars, age, experience, and salary required, etc. to "ISIS," C/o Cox's, 4 Oxford Street, W.C.

D. Telegraph, Morning Post. 27th Nov. 1911.

Harrow

17th November 1911.

Dear Sir,

I desire to thank you for your letter of the 15th inst., and in reply to the questions you ask I may say:-

1. I require the assistant as early as possible.

2. The post is to assist in arranging and classifying a collection of antiquities, largely prehistoric, for a private museum, which is now housed in a large building in the West-end of London.

3. The salary would entirely depend upon the candidate's age and qualifications, and might range, to begin with, from One hundred and fifty to Two hundred pounds a year.

The post would probably be a permanent one to a suitable man.

Thanking you in anticipation of an early reply,

I am,

Faithfully yours,

C.J.S.T.

N. Waterfield Esq.,
The Secretary,
Appointments Committee,
Old Clarendon Buildings, Oxford.

OXFORD UNIVERSITY APPOINTMENTS COMMITTEE.

Office Hours: 9-1 P.M. AND 2-4 P.M.
(SATURDAYS, 9-1 P.M.)

Interviews: 9.30-10.30 A.M. AND 12-1 P.M.
(SATURDAYS, 9.30-11 A.M.)

Postal Address:
THE SECRETARY, APPOINTMENTS COMMITTEE,
OLD CLARENDON BUILDING,
OXFORD.
Telegrams: 'APPOINTMENTS, OXFORD.' CODE A.B.C.
Telephone: OXFORD, 225.

C.J.S.Thompson,Esq.,
Grey Friars,
Harrow-on-the-Hill.

15 Nov. 1911

Dear Sir,

I am obliged by your letter of the 14th instant with reference to your inquiry for an Assistant in Archaeological work.

We shall be happy to be of what use we can in the matter, but we cannot very well suggest names without having some further particulars as to the nature of the post. Could you kindly tell us know,

(1) When the Assistant is required.
(2) If the post is a Museum post, or whether the man is required for field or exploration work.
(3) What Salary would be offered?

Any other particulars as to the nature of the post would be of great use to us.

On hearing from you I would then inquire in likely quarters in Oxford and particularly of my friend Mr. D. G. Hogarth, the Keeper of the Ashmolean Museum, who has a wide acquaintance among the younger Archaeologists.

Yours truly,

R. Wallis Field

Secretary.

[illegible]r 1911.

Dear Sir,

I should be glad to know if you could kindly recommend me a gentleman, somewhere between the age of twenty-two and thirty-five, ~~which~~ who would be capable of acting as assistant in archaeological work.

It is desirable that he should be a thoroughly reliable man, and should have a good knowledge of prehistoric antiquities, also of objects of the Stone Age, and early pottery.

The appointment would be a permanent one for a suitable man.

If you cou[illegible]with a likely individual, I should greatly appreciate your kindness.

Thanking you in anticipation,

I am,

Faithfully yours,

C.J.S.T.

The Secretary,

Oxford Appointme[illegible]

Oxford.

Sept. 4th, 1911.

My Lord,

Mr. Arthur D, Passmore has applied to me for a post as assistant in archaeological researches, and has given me your name as a reference.

I shall be glad to know if you can recommend him as being a perfectly trustworthy and reliable man of good character.

I shall also be glad to know if you consider him assiduous in his habits, strictly honest and capable of carrying out instructions in matters relating to confidential work.

Any other particulars you can kindly furnish me relating his abilities or knowledge I should greatly appreciate.

Thanking you in anticipation of an early reply,

I am your lordship's obedient servant,

The Marquis,
Bath,
Longleate,
Warminster.

Sept 4th, 1911,

Dear Sir,

Mr. Arthur D. Passmore has applied to me for a post as assistant in archaeological researches, and has given me your name as a reference.

I shall be glad to know if you can recommend him as being a perfectly trustworthy and reliable man of good character.

I shall also be glad to know if you consider him assiduous in his habits, strictly honest and capable of carrying out instructions in matters relating to confidential work.

Any other particulars you can kindly furnish me relating his abilities or knowledge I should greatly appreciate.

Thanking you in anticipation of an early reply,

Faithfully yours,

Mr. Reynolds.
The Square,
Swindon.

Sept. 4th, 1911.

Dear Sir,

Mr. Arthur D. Passmore has applied to me for a post as assistant in archaeological researches, and has given me your name as a reference.

I shall be glad to know if you can recommend him as being a perfectly trustworthy and reliable man of good character.

I shall also be glad to know if you consider him assiduous in his habits, strictly honest and capable of carrying out instructions in matters relating to confidential work.

Any other particulars you can kindly furnish me relating his abilities or knowledge I should greatly appreciate.

Thanking you in anticipation of an early reply,

Faithfully yours,

Col. Copeland F.S.A.
Victoria Parade,
Ramsgate.

Salary
A

9 Newbridge Road
Bath. July 29th 1911

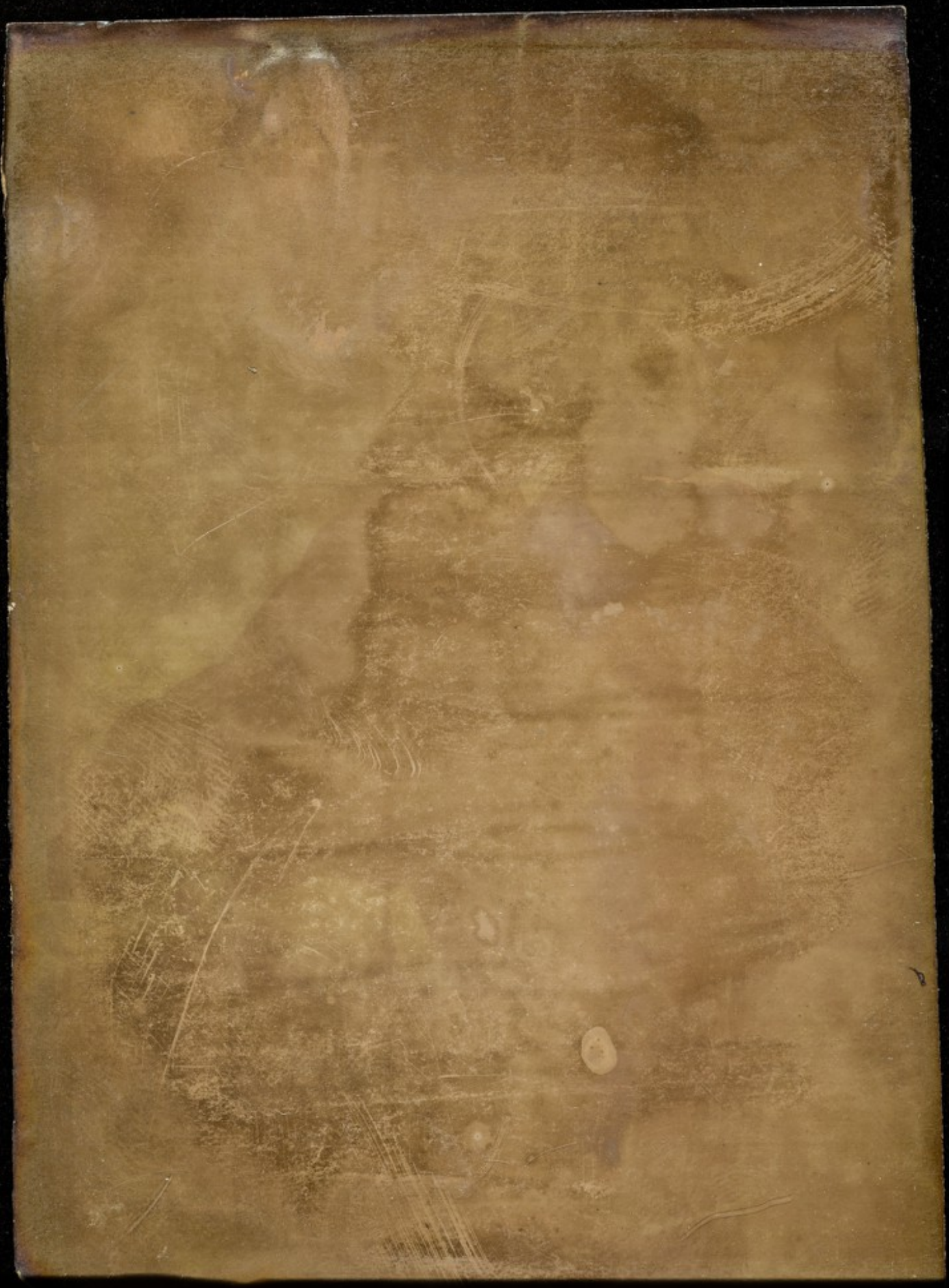
Gentlemen

2 pics
1

In reply to your Advt
in to days Telegraph. May
I offer you my services. I
enclose a rough Photo of
self. I am Middle aged -
Strong. Energetic. Active &
reliable. I claim to have
good experience in the work
Opening Banns with the late
Canon Spencell of Durham
The late Dr Silas Palmer of

Newbern. Also with Mr Walker
Mowry of the same town
I am also an expert Photographer
And have done a lot of work
in many every Cathedral
in England. And much
other Archaeological work
in odd corners of the
Country. I can entrol Men
Am of good appearance &
address. And at present
disengaged. I highly used
to Travelling. And although
I do not propose to use the
pick & shovell like a
Buck navvy. I can take
my place in a gang & see
nothing is broken & taken
away. Should this application
meet with your favorable
consideration. And an
interview be desired. I could
meet you by appointment —
when Terms &c. could be
discussed —

I am Gentlemen
Respectfully Yours
Thos B Howe



EASLEY MEWS,

WIGMORE STREET, W.

Aug. 25th, 1911.

Dear Sir,

Re Archaeological Assistant.

With reference to the above, for which you made application, I shall be pleased to have an interview with you on the subject if you can arrange to come to London for the day, and I shall be pleased to pay your fare one way.

I can see you at above address at 2 o'clock on Monday afternoon next.

Easley Mews is a short passage between 60 and 62, Wigmore Street, London, W., and the entrance to this building is at the bottom of the Mews, where you will see my name on the door.

If this is convenient to you, kindly let me know by return of post.

Yours faithfully,

Mr. Thos. B. Howe,
9, Newbridge Road,
Bath.

EASLEY MEWS,

WIGMORE STREET,

LONDON, W.

Aug. 26th, 1911.

Dear Sir,

With reference to my letter of yesterday, will you kindly call and see me on Wednesday next, At 2 o'clock, instead of on Monday, as originally suggested.

Yours faithfully,

C.J.S.Thompson,

per

Mr. Thos. B. Howe,
9, Newbridge Road,
Bath.

EASLEY MEWS,

WIGMORE STREET,

LONDON, W.

Aug. 28th, 1911.

Dear Sir,

Yours of the 26th duly to hand, from which I note that you would be unable to see me in London on Monday. You will already have received my second communication, altering the date to Wednesday, and if you could see me at above address on that day at 12 o'clock prompt, I shall be glad to have an interview with you on the matter.

With regard to the further particulars, I desire to meet with a gentleman to assist in archaeological research work and probable excavations abroad. It will be necessary for him to have some knowledge and experience in pre-historic antiquities, the identification of early pottery, etc., and one who is imbued with the spirit and enthusiasm necessary for the carrying on of archaeological work.

Judging from your letter, you state you have good experience, and are thoroughly used to travelling.

Before going further into the matter, it would be necessary to have a personal interview. I shall therefore be glad to see you on Wednesday next, as stated, at 12 o'clock, if you can make it convenient to come.

Kindly write me by return of post.

Yours faithfully,

Mr. Thos. S. Howe,
1, Majenta Place,
Bath Parade,
Cheltenham.

Sept. 20th, 1911.

Dear Sir,

I desire to thank you for your letter of the 14th, inst, but I am requested to infrom you that the appointment is now filled.

Faithfully yours,

Thomas B. Howe Esq.,
9, Newbridge Road.
Bath.

1 Magenta Place
Bath Parade
Cheltenham - Sat. 26th-11

Dear Sir

your letter of the 24th has been sent on to me from home (Bath.). I finish my contract here on Tuesday Aug 29 Can you fix another date for an interview? Monday it will not be possible to come. When writing will you give me some idea of the work you wish carried out I enclose a very rough - unmounted Photo of self. And I will give you any other particulars and references you may wish

The Fare from Bath to London - is 18/6 return.
The offer of half is hardly sufficiently tempting - but now I know some what - what you want. And the duties I am to perform. I just bear in mind that I can - Your Advt & answered it But it must be at least a month ago. If you answer by return I shall get it here. (note address) Bath on Wed 30th Inst

I am Dear Sir
Respectfully Yours
J. H. B Howe

1 Magenta Place.
Bath Parade. Cheltenham
Aug 29th - 1911

Dear Sir

Your favr of the 28th
And your second letter allerny
the date just received.

I leave Cheltenham to day
for Bath. And I had almost
made up my mind to proceed to
Cardiff where I have been in
Correspondence with A gentleman
in the Morgan Arcade. to
represent him as Travellers in
Tools & Machinery for the

Mining district of S. W. & Midlands of England -

However. I can by leaving Weston where I live (It is a Suburb of Bath) quite early I can arrive at Paddington at 10-30 and be at Wigmore Street by 12 o'clock Sharp. I think & feel that I could fill all the conditions you name. The whole thing is Congenial to me. And I know it is only those who have the spirit & enthusiasm necessary for the endless care & watchfulness in the work. Who succeed in carrying out Archaeological research. You did not notice my remark. Re Travelling Expenses. The return fare & W. & is 18/- a week about. Will you pay that. If so I will be Bath. will insure my coming

I may add that my means are scanty. And with the greatest care & economy I can barely make both ends meet. I am married

two children And have only
done four months work in the
last year - A temperance man
highest references. to Any
merchants Strong, Healthy &
Possessing Wide experience
can give you 25 years good
record. Excuse Paper Pencil &c
I am writing this on Railway
Platform. while on my way to
see A customer. Fountain Pen failed

Faithfully Yours
Thos B Howe

9 Rudridge Road
Bath. Aug 29th 1911

Dear Sir

Just a line to confirm my message. That I will meet you as arranged at Rooms Prompt. at Wilmot Shell to-morrow Wed. 30.

Faithfully Yours
Chas Howe

9 Newbridge Road
Bath. Sept. 14th 1911

Dear Sir

Since my interview with you I have been endeavouring without avail to secure some of Pre-historic Pottery. I took some years since of the opening of the Tumuli & Barrows of Hants and Berks in which I was engaged by the late Dr Silas Palmer and Canon Greswell of Durham and other Archaeological Gentlemen

As I came to Bath April 19 in the year 1894. and this was some time previous. and I have not been in touch with these people since. You can quite understand

what with death removing some and the others were old men at the time. That I cannot find out where any of that copies can be found. It has just struck me while writing this. That there may be one gentleman. Walter Money Esqr. F.S.A Newbury Berks

if still living - who would remember me well & the work I did. He also engaged me to do some things I found at Speen - And also in the Photography of The Falkland Memorial at Wash Common. An Obelisk that He (W. W. Money) promoted & got up by subscription. And was opened by the late Earl of Carnarvon of Highclere Castle. And to whom Lord Falkland was originally or otherwise connected. Or to

Mr Walter Blacket
Publisher.
Newbury —

who published. Mr Money's Books and also Dr Palmers. Transactions of Field Clubs. And to whom I supplied & mounted the photographs that were used as illustrations

Any way if Photography is to be one of the uses I am to be put to. If you will send me any article or object that you have not succeeded in getting well done & rendered. Although I have no Apparatus for the best production of the work. I have several lenses. I will copy

And send it you back the next day
And do the best I can with it under
the difficulty. Or if I can give
you a demonstration in London
I will cheerfully do so - either
in portrait. View. Street Scenes
or groups. And I can easily prove
to you that in that respect I am
Proficient. From 19 April 1894
I carried on a good middle to
high Class Studio at 44 Milsom
Street Bath - until May. of last
year. Our prices were Cabinet Portraits
18/ to 30/- per dozen. And
while there I produced at least
30.000. Negatives. Since that
I managed Mr. Baseri. business
Abbey Studio. Malmsbury.
Wilts

He does A small but good
Class business amongst The Duke
and the Hunting gentry -
I was six weeks at Von Tempsky
Studio - Temp Road Brighton
Manager Mr. Hutchings.
This is A good class Studio - All
Electric. average 50 Sitters per day
your order. one to 20. portraits of
Self turned out in 1 hour. Since
then I took Charge of A good
Class business.
Miss - Holloway
32 Cambray
Cheltenham
where your first letter to me was
sent. And I can confidently
refer you to any of these people
Also to Some London

Firms.

Mr James Wisbey
Messrs James Wisbey & Co
Corner Houndsditch

Known one - 20 years -

Mr Abrahams.

Messrs. Hyman & Abrhams & Son
Houndsditch

Messrs Payne & Son
Fancy Warehouse
14 High Holborn

To these people I am better known as House of Newbury. As I did no fancy trade at Bath

---

locally

Geo Sturges Esq
Warwick Rd
Bath

This gentleman is Valuer & Auctioneer. And a partner in the Firm of Messrs Powell & Sons Ltd Paddington & Bath.

The Rev J. J. Church
Combe Park
Bath

Rev^d^ T Walters
8 Park Road
Bath

Mr Rodd
Chelsea Road
Weston
Bath

Howe

The last named is my landlord
in whose house I have lived
the last eight years

I can give you at least
a score of other people - if
you wish. I regret I cannot get
the old Photos. I mentioned
but they were not of general
interest. Only to the few Oxford
Professors. Dons & the few clergy
and gentry in the neighbourhood
with whom I did not have much
to do with personally. As the
business transactions were done
by the Hon. Sec. Awaiting yours

I am dear Sir
Respectfully yours
Thos B Howe

9 Newbridge Road
Bath. Sept. 24th 1911

Dear Sir

It was with profound regret that I read your letter and found that I was not included in your party for the archaeological excursion work that I have so much interested in. I can only repeat that I would have been an active & enthusiastic member & as a labor of love it would have been cheerfully carried out.

Did you see the cutting in

Daily Mail of last Monday!
a fine Article in the Field of
Sept. 16. Although this may
have nothing to do with you
I raised a funny desire in
my mind to be in it

Since my interview
with you I met a man
whom I have known many
years. But have not seen for
some time. He is a remarkable
man. as old as I am or
nearly so. He has had a large
and varied experience in

Saxon & Romans explorations
He is a practical Mason an
Artist. Sketches well. His
Plans. dimensioned drawings
are equal to the best you have
ever seen. He is an educated
man. A Temperance man
Hard as stone. what Thing a
healthy. His hand writing is
as bad a worse than mine
But He would be an immense
acquisition to any party
His price would not be a
large one. He has no one
dependant on him. And his
love for Archaeological research

has reduced him from a big
and successful Builder of
Churches &c to his present Humble
but happy position. He is a
relative of Mark Tapley. And
should you have room on your
or similar staff - he would
be most interesting -

His name is

Richard Deane
31 Thomas Street
Bath

I have not mentioned to him
that I had seen or heard of
you. And it is only Fanny
his quasi creations that I summon
him to you. Should you

reconsider your decision. I
am still available.

With sincere regards
I am Sir
Respectfully Yours
Thos B Howe

P.S. This Mr. Brown is very
often in the British Museum
Library.

Wanted.

ARCHAEOLOGIST. Assistant required with good general knowledge of Egyptology and Archaeology generally, to assist in excavating. Write full particulars, age, experience, qualifications, and salary required, to YTX, C/o Gould & Portman, etc.

Athenaeum, Friday, 28th July 1911.

Daily Telegraph, Morning Post, Daily Mail, Saturday, 29.7.11.

22 Ranelagh Gardens
Bedford Park London W

1911. VII. 29

£ pottery

A * £ 30 per

Seen

Sir

I beg to apply for the position of Assistant Archæologist advertised in today's "Daily Mail".

Experience

I was for 15 years Assistant in the National Museum of Ireland and am thoroughly trained in technical work, the method of research, accurate observation, and the preparation of Descriptive Reports.

Our Collections of Egyptian, Cypriote, Greek and Roman Antiquities were not extensive but afforded a general acquaintance with Egyptology, and Classical and pre-classical Archaeology.

Our Collections of the Stone and

Bronze Ages formed a valuable training for the identification of similar objects in other countries.

Having been detached on several occasions for the organization of special branches of the Department of Agriculture and Technical Instruction (under which the Museum was placed on its removal from the Science & Art Department) I have had experience of organisation, management of labour and accounts.

Salary

I presume that the passage to Egypt would be paid and that the expenses in camp are small: I would therefore suggest £150 a year and a special arrangement as to Mess-expenses.

Age

40 years. I was brought up in Siam and am suited constitutionally for work in hot climates.

I am, Sir,
your obedt servant
E. H. Alabaster

"Y. I. X."
c/o Gould's
54 New Oxford St W.C.

? for Silvery
and Hymn

LINDSEY HOUSE,
100, CHEYNE WALK,
CHELSEA.

The Hermitage
White Hall
Bletchingley

Dear Sir

I have known
Mr. R.S. Clarke for
a good many years.
I have a great
regard for him.
I consider that he
is thoroughly honorable

and reliable. ——
Clever and well read.
I should think that the
other book you should
I would be exactly
suited to his ability.
Not being an archæologist
myself I cannot
say how much he
knows of the subject.
But I cannot think

his strength of this
friend — man of culture.
Please excuse a badly
expressed letter. I am
undergoing a "rest cure" —
letter writing is strictly
against the rules!

Believe me
Yours sincerely.
Hugh Lane.

To C. G. I. Thomson Esq.

Aug. 17th, 1911.

Mr. E.W. Alabaster,
22, Ranelagh Gardens,
Bedford Park, London, W.

Dear Sir,

Re advt. Archaeological Assistant.

In reply to yours of the 20th, will you kindly call and see me at the offices of Messrs. Epworth & Co., 69, Newman Street, at 2.30 to-morrow (Friday) afternoon, when I can go into details at our meeting.

Yours faithfully,

practical experiment in research

Results = Anticipated Objects =

Methods or simple = problems

experiences

what did he learn =

Franke + Herman

EASLEY MEWS,

WIGMORE STREET,

LONDON, W.

Aug. 28th, 1911.

Dear Sir,

With reference to our interview on the 21st, I shall be glad if you would kindly call and see me at the above address on Wednesday next, at 12.30, when I hope to come to a definite decision concerning the appointment.

Easley Mews is a short passage between 60 and 62, Wigmore Street, London, W., and the entrance to this building is at the bottom of the Mews, where you will see my name on the door.

I am,

Yours faithfully,

Mr. E. W. Alabaster,
22, Ranelagh Gardens,
Bedford Park,
London, W.