

Artificial Fertilisation of Rabbits

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A plea to experiments on the artificial fertilisation of mammalia - by F. G.

It seems reasonable, on the following grounds, that experiments should be made on the possibility of artificially fertilising mammalia beginning with such inexpensive animals as mice and guinea-pigs.

The two facts, that a single spermatozoon suffices to fertilise an ovum when brought to the proper place at the proper season, ~~and that~~ ^{while} the number of them secreted by the male is enormous, show that a vast quantity of material is wasted. A breeder is unable at present to widely introduce ^{in a single generation} any fresh strain of exceptional value, that may chance to make a sudden appearance as a sport, and is therefore hereditarily transmissible. Therefore if artificial fertilisation prove to be possible, by using only a minute portion of the available material, a new and valuable power would be placed under the control of breeders.

There are two main heads for experimentation -

- (1) On methods of preserving spermatozoa in ^{health and vigour} ~~life and in fertilising~~ during many days.
- (2) On the possibility of fertilising, with fair average success, by mechanically conveying to the mouths of the Fallopian tubes, a minute fraction of the available material.

As regards (1) it is conceivable that some culture fluid should be found, more conducive to the vitality of the microbes than that in which they naturally live. They are said to live in milk; therefore other appropriate fluids may exist, possibly ~~at~~ the more suitable if oxygenated, that would admit of their being kept in vigour for some days, and of being easily transported.

As regards (2), the artificial fertilisation of women, whose husbands have hypospadias, has been tried with success on a considerable scale. Hunter was the first to attempt it, it then became forgotten, but has been reintroduced both in France and in America during recent years, by ^{making} one injection monthly, soon after the cessation of the menses. Particulars may be found in Tarnier, "Art des accouchements" Paris 1882, p 176

(see also p 176
on the
injection of
spermatozoa)

The apparatus there described might doubtless be further simplified and reduced in size, considering how minute an application is necessary, if directed to the right place. The immense waste of material, ^{under the ordinary conditions,} is due to the non-fulfilment by nature of this requirement, as may be inferred from the fact that the amount of the material discharged by different animals varies roughly with their size although that of the individual spermatozoon is ^{about} the same ^{in all, as} in the rat, the dog, the man, the horse and the bull. In other words, the number of the microbes that are discharged, is proportionate to the area of the walls of the canal about which they have to be wastefully dispersed, on the chance of ^{some} of them reaching the required spot.

It is scarcely possible to think of the practicality of artificially fertilising domestic animals, without extending in imagination its application to humanity under some ^{different} form of civilisation to ~~the~~ our own. We know that it is a process which might be effected by female surgeons, in a purely female establishment, even under anaesthetics if thought desirable, and without wholly destroying the Levitical ^{proofs} of virginity. In short, that a maid might bear her first-born to the State, wholly unaided by sexual passion.

F. G. June 28/94

Artificial Impregnation
of Mammalia
1896 F5

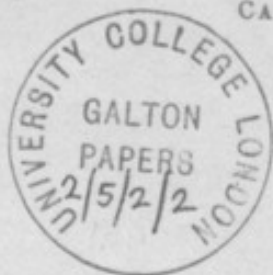


Heape

F. 1

1. July. 94.

ST MARYS.
TRUMPINGTON,
CAMBRIDGE.



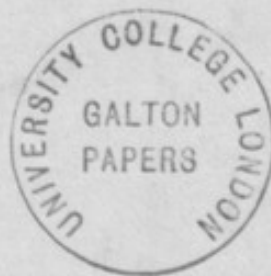
Dear Sir,

In reply to your note
of the 29th. I beg to assure
you it gives me very great
pleasure to have the opportunity
of placing at your disposal
not only advice, but any help
I can possibly give you, with
regard to the experiments you
are desirous of making.

I hope you will, as you
suggest, send me a short
account of what you propose
to do, together with any queries
which may occur to you.

Yours faithfully
Walter Heape.

Francis Galton Esq. F.R.S.



Walter Heape

f. 3

3. July 94.

ST MARYS.
TRUMPINGTON,
CAMBRIDGE.



Dear Sir,

I have much to say on
the matter of the experiments
you suggest: your note of which I have
duly received this morning and
read with very great interest.

I shall be in London tomorrow,
and would call upon you at 4 P.M.
for an hour, if it will be convenient
for you to receive me there. May I ask
you to send me a telegram on the
receipt of this letter, as I leave here

Early tomorrow morning.

If tomorrow Wednesday at 4 is not convenient I could come on Thursday morning about 9.30 or 10, and if neither day suits you I will write on my return home.

I should like to tell you of some experiments I have been engaged in for some months past, upon the mechanism of ovulation; they bear somewhat closely upon considerations which ~~are~~ your proposed experiments will necessitate - & they will I think interest you.



I will of course regard your communication
as strictly private.

Very faithfully yours
Walter Haepe

Francis Galton Esq

Heape

f. 5

9. July. 94.



ST MARYS.
TRUMPINGTON
CAMBRIDGE.

My dear Sir,

I send you a line to say

I have consulted Pathologists here
and am advised to try sterilised
hydrocort fluid as a medium for
spermatozoa. It may be some
time before I can get this, properly
prepared, but as soon as I can get it
I will begin experiments, and will
keep different percentages of spermatic
fluid at various temperatures.

I merely send you this hurried
line to let you know what I am
doing in the matter, pray
don't trouble to answer the letter
unless indeed you have suggestions
to make.

Yours faithfully

Walter Heape.

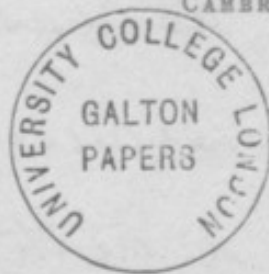
Francis Galton Esq



31. July. 94.

ST MARYS.
TRUMPINGTON,
CAMBRIDGE.

Dear Mr Galton,



I hasten to send you a
line today & will, until I hear
from you, write only in such
manner as may allow of your
sister reading -

I put some spermatic fluid into
sterilised hydrocoll fluid on
Saturday ~~He~~ left it until
Monday in an incubator - the
tubes were unfortunately, by error,

but see no reason why half a
dozen experiments should not be
performed in that time -

Very faithfully yours
Walter Heape.



removed two or three hours before
I was able to examine them -
I found spermatozoa therein, but they
were motionless, & a lively &
plentiful crop of bacteria was also
present - The latter were doubtless
introduced with the spermatic fluid
& a plan must now be devised to
obtain the spermatozoa free from
such contamination -

A great proportion of the spermatozoa
in the hydrocele fluid had no marked
appearances of degeneration, & there seems,
so far, no reason why they should not
live if proper precautions are taken -

I think it will be advisable to gain the assistance of one of the trained bacteriologists in the pathological laboratory here - the experiments will be more reliable and more valuable to you if they are performed by one who is fully conversant with all the methods of that science -

If therefore, you are agreeable I will find someone who will undertake this part of the work and we will together report to you -

Please let me have a line before you leave tomorrow - I shall, myself, be much away for the next two months



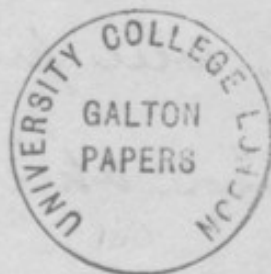
W. Heape

f. 9r

ST MARYS.
TRUMPINGTON.
CAMBRIDGE.

14. Oct. 94.

Dear Mr. Galton,



I have delayed answering
your letter in the hopes that I
might be able to tell you the
experiments are progressing, but
unfortunately I cannot say so -
My stock of Rabbits altho' large
do not include either bucks or does
in a breeding condition. They are
all either casting their coats or

manipulation, and he does not doubt they were present in the spermatic fluid which was taken from the vagina before it was extracted therefrom.

This appears to me exceedingly likely and I do not think any satisfactory experiment in the direction of preserving the spermatic fluid can be performed until it can be obtained by artificial means, viz by the ejection of it without ~~and~~ copulation, into a properly sterilised vessel.

Hitherto I have been unable to effect

by artificial means, the ejection of spermatozoa

otherwise so affected that they
are not in breeding trim; -

I have several times found that at
this time of the year a similar
condition prevails & I fear it may
be some weeks before they can be
induced to do their duty in this
respect —

The last experiment Dr. Barlow & I
performed was to extract spermatic
fluid from the vagina of a doe (killed
for the purpose) a few minutes after
copulation & to place the same in

(and keep it at 37°-temperature)

hydrocoele fluid). The greatest care was taken & every precaution adopted to obtain the spermathe fluid ~~in~~ free from septic organisms and the hydrocoele fluid was sterilised, but nevertheless about 4 hours afterwards the movement of the Spermatozoa had diminished in rapidity at three hours later they were motionless & apparently dead. At the same time there was a considerable growth of bacteria in the hydrocoele fluid.

Dr. Barlow is quite certain the presence of the bacteria was not due to faulty

ST MARYS,
TRUMPINGTON,
CAMBRIDGE.

from a Rabbit - Ifancy it might
be managed by introducing a
stuffed rabbit into the cap of a buck
which has been sufficiently excited
by a doe in heat, and by fixing a
sterilised tube in the place of the vagina,
it might be necessary to bind fold
the buck, but I think it might be
done and I propose to try it as soon
as my bucks are in breeding trim.

Dr. Barlow thinks it is very doubtful
that a highly specialised cell such as
a spermatozoan ~~can~~ will live long in

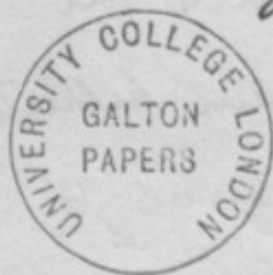
very unnatural medium; but when it is remembered that they live in the male organs for some time after being discharged from the testis & that they live for ~~over~~ 2 or 3 days at least in the female organs after copulation, it seems to me that they may be said to exhibit very considerable hardihood and that it is by no means unlikely they may live in a satisfactory medium for a similar length of time.

I have tried putting a tube into the vagina of a living doe but have hitherto not succeeded in collecting spermatozoa in it.

The experiments connected with artificial
 fertilisation with diluted spermatozoa
 I will also try as soon as my stock
 are in a satisfactory condition -

I am sorry the work has not already
 reached a more advanced stage, -
 I was fairly tired out by the middle of
 August, and went away to Scotland
 for the shooting - returning only 10 days ago.
 Hope you have had a pleasant
 holiday.

Yours faithfully
 Walter Heape.



ST MARYS,
TRUMPINGTON,
CAMBRIDGE.

21. Nov. 94.



Dear Mr. Galton,

You will surely wonder what I have been doing and I am sorry to be obliged to say "nothing" - I cannot prevail upon my stock of rabbits to breed, I hope before long to be more successful with a new lot and will let you know as soon as I have any news for you.

I hope you will not feel I am neglecting your experiments. The fact is, the more I investigate the subject the less I find is definitely known about it and I am driven back further & further to experiment upon points it is requisite to know before attempting to tackle the problem you have suggested.

Any work connected with breeding is necessarily slow as I know to my cost, and this time of year is



Can you refer me to any other
account of successful artificial
fertilisation - you may remember
you gave me Tarnier as a reference
and I know of no other -

Tarnier gives only two experiments
on the lower mammalia only
Spallanzani & one by Pierre Rossi
about 1780 - Obviously the experiments
on women which he records are
not entirely trustworthy for one
cannot be assured that the
artificial injection was not

subsequently supplemented by
copulation.

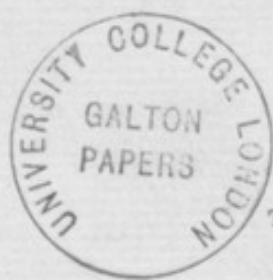
I am thinking of making a few
preliminary experiments upon
artificial fertilisation to see if
the presence of the male fluid in
the uterus is alone sufficient to
produce ovulation. It seems to me
to be as yet uncertain, and I shall
be very much obliged if you can
tell me of any published account
having
~~of~~ ~~the~~ reference to this point.

especially unsatisfactory.

I hope I may be able to send you
a more satisfactory account
before very long.

Very faithfully yours
Walter Heape.





ST MARYS,
TRUMPINGTON,
CAMBRIDGE.

5. May. 95.

Dear Mr Galton,

I have but little to tell
you I am sorry to say -
we have failed entirely in our
efforts to procure effective
Spermatozoa for more than a
few hours. The Spermatozoa has
been obtained from the vagina of
female rabbits a few minutes
after copulation, and placed
in sterilised hydrocele fluid - but

the difficulty is that the injection
of spermatozoa alone does not
appear to be sufficient to produce
ovulation in Rabbits. I have
now ~~just~~ killed a very considerable
number of doe rabbits, and have
never found one in which ovulation
has taken place without copulation.

Electric stimulus of the vulva
& vagina, which a doe always
readily submits to, does not

in a very short time bacilli made
their appearance and rapidly fill
the fluid. the sperm die -

I see no hope of success in this
direction. The spermatozoa must
be obtained direct from the male
in a sterilised condition in order
to give it a chance of living -

Rabbits are not convenient animals
to work with for this purpose, it
does not seem to be an easy matter
to induce artificially the ~~ejaculation~~
ejection of sperm. from a rabbit.



In dogs this is readily done - and I would suggest that some experiments should be made with dogs as soon as artificial fertilisation can be performed with some certainty.

At present I have not succeeded in fertilising artificially, rabbits - I have injected sperm: into the vagina and the sperm: has found its way into the uterus, that is not the difficulty we have to contend with,



5

f. 18r

ST MARY'S,
TRUMPINGTON,
CAMBRIDGE.

induce ovulation apparently -
I am not quite satisfied about
this point, and propose to repeat
the experiment, shortly - upon a
dog in which spermatozoa has
been injected artificially - but I do
not expect the experiment to be
attended with any success.

I know Everett Millais very well,
and know of his artificial
fertilisation of dogs, at least I am

Whatever obstacles I have placed
in their way. The act of copulation
is a very violent act with rabbits
and the vagina exceedingly flexible.
Again I have some reason to think
that the act of copulation itself is not
sufficient to induce ovulation, I am
inclined to think the presence of sperm
in the uterus is also a necessary factor.

In one case of a doe rabbit on heat
which copulated fully, the uterus
was blocked up and the spermatozoa
did not penetrate beyond the vagina.

under the impression that I know
 of all his experiments - he may
 have done some which I do not
 know about, and will write and
 ask him - Those I do know of
 are not purely artificial fertilisations.
 He injects the sperm: say of a
 St. Bernard dog into a Basset hound
 bitch and then has that bitch
 covered by a dog of her own breed
 the result being that she breeds
 some ~~perfect~~ pups pure basset hound
 & some $\frac{1}{2}$ basset & $\frac{1}{2}$ St. Bernard.



by this means to get a cross between two varieties, which could not be done together on account of their different size &c.; but you will observe that copulation is not omitted from this experiment, and I cannot help thinking that copulation is essential to the success of his experiments.

I have attempted to allow copulation and at the same time to prevent the entrance of sperm: into the uterus, but in all cases have failed to keep them out, they have circumvented



9

f. 20

ST MARYS,
TRUMPINGTON,
CAMBRIDGE.

and in this case ovulation did
not take place.

It is a very interesting problem

I surely its solution is likely to

establish several important

points connected with breeding,

but I confess the solution appears

to be a long way off yet.

Of course very many experiments are

needed to prove a negative proposition,

and I do not for a moment delude

myself with the belief that my

experiments prove anything at all,
but they certainly seem to indicate,
that the act of copulation and
the presence of spermatozoa in the
uterus, are both necessary in order
that ovulation should take place
in the Rabbit.

I have been far from well for the
last 6 weeks or more and have done
but little work; I hope soon to be
busy again however and will let
you know the results of my
experiments.

I have judged that experiments
upon the preservation of spermatozoa
may with advantage be left until
artificial fertilization is demonstrated.

Believe me

Yours faithfully

Walter Heape.



11. May. 95.

ST MARYS.
TRUMPINGTON,
CAMBRIDGE.



Dear Mr. Galton,

I have heard from
Millais and he tells me he
has repeatedly fertilised ~~the~~ litches
by injecting spermatozoa into
the vagina & without any
copulation. He also tells me
he has put three litches in pup from
"the single emission of the dog" -

I expect to be in London before
long and would call upon
you if convenient to you.

Very faithfully yours
Walter Heape.



This seems to be what you want.

It is very curious that artificial fertilisation should be possible for the dog & ~~not~~ apparently impossible for the Rabbit: -

I expect the difference will be found to be due to differences in the maturation of the ovum.

In some mammals I know it is said that maturation takes place after the ovum is shed from the ovary, while in the case of the

Rabbit I find the ovum matures
while in the ovary and does not
mature until about 9-11 hours
after copulation.

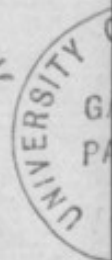
I don't know where maturation
of the ovum takes place in the dog.

Possibly the extent of the phenomenon
of "heat" affects maturation -

bitches are of course greatly affected
by "heat" - I should much

like to see you about this point

some time.



W. Heape June 25

F. 24

25. Jan. 95.



ST MARYS.
TRUMPINGTON,
CAMBRIDGE.

Dear Mr Galton,

I have no news for you

I am very sorry, a variety of

private matters having combined

to stop my work for the last 6 weeks.

I hear ~~that~~ ^{that} artificial fertilisation

is being used in America for horse

breeding, but have not yet discovered

the source of the information.

I will not communicate further
to you on this subject until I hear
of your return from the Continent,
where I trust you may spend a very
pleasant time.

Yours very faithfully
Walter Reape.



ST MARYS,
TRUMPINGTON,
CAMBRIDGE.

11. OCT. 95.

Dear Mr Galton,



I am sorry to say I
have really nothing of
importance to tell you -
I have completely failed to
fertilise artificially a doe
rabbit - Spermatozoa injected
into the vagina may find its way
into the uterus & this has occurred
in some of my experiments, but in

There is one point which seems
to me of very considerable interest
and which may be found to be
of importance. I mean the time &
place of maturation of the ovum,

In the Rabbit I find from a long
series of experiments that maturation
takes place a definite time after
copulation, & only after copulation,
and ^{yet,} before the ovum is discharged
from the ovary — It seems from

Loeb's researches that in some

no case has ovulation taken place.
Copulation appears to be necessary ~~to~~
in order that ovulation should occur
in the Rabbit - I am quite
prepared to believe this may not be
a necessary adjunct to ovulation
in other animals but I am
strongly of opinion it will be found
to be necessary for Rabbits -

I have tried stimulation of the
vagina & of nerves supplying the
vagina uterus & ovaries, I get a
reaction in the muscular organs



which it is highly probable are
very similar to the movements
which take place in connection
with copulation, but as far as
I can see the ovary is not affected.

I have found no stimulation which
affects the vascular supply to the ovary.
It is this I want to find -

I have not done much so far and
breeding is now a very uncertain
matter, however early next year
I shall begin again.

ST MARYS,
TRUMPINGTON,
CAMBRIDGE.

Rodent^{um} maturation of the ~~ovum~~^{ovum}
takes place after its discharge from
the ovary - The influence which
brings about maturation changes
in the Rabbit would seem then to be,
possibly, more complicated than in these
other Rodent^{um}.

Another point of interest is the
uniform appearance of a discharged
follicle: it seems to be pinched



Ripe follicle (A)



discharged follicle (B)

If you can make any suggestions
may let me have the benefit
of them -



together at its lower end -
 when an ovary containing ripe
~~of~~ vesicles is put into strong nitric
 or acetic acid, the ripe follicles
 rupture and the walls of these
 follicle take the same shape as do
 those ruptured naturally (B)

I am in communication with a
 gentleman who promises me interesting
 details of methods adopted for artificially
 fertilising mares, & when I know
 particulars will send you word.

I am sorry I have so little to
 tell you, but I find this line
 of research full of interesting
 difficulties and as there seem to be
 no authentic experiments to help one
 breeding is a "tickle business" at all
 times one must expect but slow
 progress.

I hope you have had a good holiday
 and that you have benefited by it.

Believe me faithfully yours
 Walter Reape.



W Heape

f. 30r

25.00.95.

ST MARYS,
TRUMPINGTON,
CAMBRIDGE.



Dear Mr Galton,

I think the enclosed
will interest you. Please let
me have them back when
you have read them.

I expect shortly further information
on this matter I will keep you
informed of anything that
I think will interest you.

Here seems clear evidence that

f. 30v
"The Horseman" to be obtained at
American newspaper agency . . . King William K. Strand
a writer? "on Breeding Mares" } "The Horseman"
Chicago Horseman Newspaper Co
Chicago Ill.
March 8. 1894 p. 279
Again a writer? "artificial Impregnation" - May 30/1895 p. 677

Also a letter from
Samuel Cook - Harris - Ill. - Aug 27/94
full details



a mare can be artificially
~~in~~ fertilised quite independently
of copulation - and that the
seminal fluid collected from a single
service is amply sufficient to
fertilise two or three mares.

The ease with which these large
animals can be worked makes
them excellent objects for experiment
but I am afraid they are too
expensive for my purse.

It would be worth while if I should

to communicate with breeders
 who have difficulty with their
 mares, may I ask you to let
 me know in case you hear of
 such.

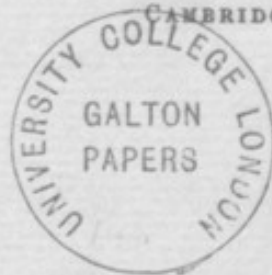
I must set to work again upon
 the preservation of spermatozoa -
 I wish I could get it in larger
 quantities, than is available from
 rabbits.

Yours very truly

Walter Heape.

31. Oct. 95.

ST MARYS,
TRUMPINGTON,
CAMBRIDGE.



Dear Mr. Galton,

Pray forgive me for
delay, it was unavoidable.

By all means write to Dr. Bellings
on the subject - I do not want to
keep the matter in my own hands
at all -

I shall hope to identify myself with
the work to be done on the subject
I shall do all in my power myself
but I am not so selfish as to retard

instruments in warm water until they are wanted.

I shall set to work again at the preservation of sperm: as soon as possible.

at present I am just at the point of moving into a newly built house & have my hands full; after Xmas I shall be free again, but until the new year I fear I shall not be able to give undivided attention to work.

The possibility of crossing varieties by means of artificial impregnation in cases where they will not breed



f. 33r

the investigation by keeping it as
simple.

I know of no one who would be
better to apply to for information
than Dr. Bellings, & look forward
especially to his reply to your
communication.

—
About the capsules, I have asked
for samples and will let you know
when I hear further.

—
Mr. Cook in his letter to the
"Horseman" does not quote any

fact for his opinion that light
has a more destructive power than
cold or sperm:

He makes his statement in reference
to his method of collecting sperm: ^{from} ~~from~~
a mare who cannot retain it in her
vagina. The sperm: pours out again
as the horse comes down from the mare;
he catches the sperm: in a clean pot
& covers it immediately because, as he
says, light has a very destructive power.
When he uses a syringe he keeps his

naturally, will have to be tried
if the American story is established.
And that opens up a large field.

The subject bears closely on my own
work and is of very great interest
both ~~in~~ from all points of view,
both artificial fertilisation, the
preservation of sperm; and crossing
varieties which are not naturally
fertile —

— Do you mean, by the bye, whether any
investigation has been made of the
ovary & ~~testis~~ testis of the mule, I mean
histological investigation — ?

I have an impression they are
stated to be normal but I cannot
find any reference.

May I ask you to let me know if
you can refer me to any published
account?

Believe me
very faithfully yours
Walter Heape.



ST MARYS,
TRUMPINGTON,
CAMBRIDGE.

1. Dec. 95.

Dear Mr Galton,

Many thanks to you for your

note & the two enclosures which I now
return - Pearson's letter is certainly

very important - He has himself

"practised the system with success"!

It appears to me that one now requires

proof that offspring reproduced are

not abnormal in any way, that they

possess average strength & health and

reproductive powers.

If this can be shown breeders will surely

interest and importance, and would
 it appear to me have more influence
 upon breeders than any experiment which
 I can think of.

Will you let me hear what you think
 of this and whether you are acquainted
 with ~~a~~ the owner of a ~~mare~~ stud in
 which a mare might be found to act as
 a test case.?

I do not myself know ^{personally} any owner of a
 large stud of first class horses.

Of course a mare may fail to breed one
 season and may successfully bear a
 foal the next year, so that the hope of
 "better luck next time" may make owners

gladly practice the method: but without that assurance I imagine breeders of prize stock will not adopt a practice which might so easily get them a bad name.

I was last week at Bedford and went to see Mr Peck's famous horse breeding establishment at Howbury Hall. I found that it is considered satisfactory if $\frac{2}{3}$ ² of the mares covered are got with foal bear foals. but that the proportion varies much in different years. This last breeding season has proved a bad one, an abnormal number of mares

being barren. - The high prices paid for covering mares with first class horses ~~rather breeding~~ (any price being charged from £50 to £400 per mare) would surely make owners of mares anxious to adopt the artificial method if it could be done certainly, provided the offspring produced are satisfactory.

The best way I can suggest for proving this is to induce the owner of a ~~well~~ celebrated mare, which has failed to conceive in the ordinary way, to have her artificially impregnated this next season.

The racing career and the career as stud of a foal sired would be of the greatest



difficult to persuade unless they
have a mare which has proved to be
fairer for several seasons.

I am still unsettled with regard to
household affairs, the process of removal
takes place a fortnight hence, so I hope
early next year to be able once more to
settle down to hard work.

Very faithfully yours
Walter Hscape.

I should much like to see you on the
subject of certain breeding experiments
I have in mind. I hope next year you
will allow me to call upon you & tell
you about them.

HEYROUN,
CHAUCER ROAD,
CAMBRIDGE.

18. Aug. 97.

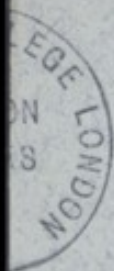
Dear Mr Galton,



Regarding the word

"Impregnation" - it seems to me that the same objections apply to its use that apply to the use of the word "fertilisation". I am open to correction of course, but I do not think it is correct to describe the insemination of an animal as impregnation.

As I understand it, to impregnate means to make pregnant, to cause to



HEYRONS
CHANGERS ROAD
CAMBRIDGE

I am very much obliged to you for raising this point, I had included the word in my first rough draft of the paper, but cut it out subsequently thinking that fertilisation was sufficient for the purpose.

Conceive - and the principle of
 infusion seems to be included in
 the word - to communicate the virtues
 of a substance by mixture, digestion
 or the like -

Spermatozoa is not incorporated with
 the female by infusion as far as is
 known, it only mixes with the ovum,
 and it seems to me that it is only
 the ovum that is impregnated or
 fertilised, not the mother.

If it ~~was~~^{is} correct to use impregnation
 in place of insemination, it would
 be equally correct to say that ~~are~~



an animal was impregnated
which had not conceived, and
this seems to be a contradiction.

At the same time no doubt you are
right in urging the advisability of
impregnation appearing as a catalogue
word, and I have written tonight
to amend the title and add a few
words in the text to make that
possible. I hope they will accept the
alterations.

Yours faithfully
Walter Hearn.