

UNIVERSITY OF MICHIGAN
ANN ARBOR

THE HARRISON M. RANDALL LABORATORY
OF PHYSICS

Dear Francis,


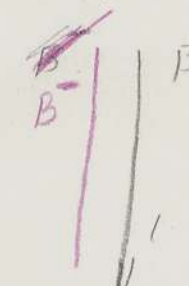
please excuse my delay in writing
but somehow things involved with students
got out of hand in the last few
months. I'm still waiting for some
photographs of poppit bead models but
I think that I can draw things
sufficiently well so that the ideas
are clear.

First pairing must take place
between open regions at corresponding
points on different (mamma and poppa)
molecules. Then the interactions must take
place which lead to the observed
heterozygotes. I'll forget the first
question except to say that perhaps

Drew Schwartz has a useful idea in
the $\begin{array}{cc} a-t & \\ | & \\ t-a & \end{array}$ and $\begin{array}{cc} G-C & \\ | & \\ C-G & \end{array}$ ~~to~~ tetrads.

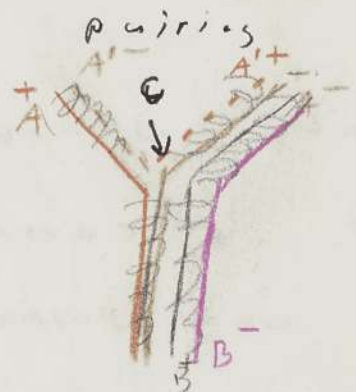
At any rate the only new thing
beyond the enclosed and what I said
last summer is the following sequence
of operations.

First set poppit beads to do the
following;

Molecule ~~one~~ A has two chains A^+ and A^- drawn as  and B has  ②

let the ~~rotation~~ ~~be~~ ~~ind~~ winding of the chains to form the double helix be indicated. I assume that the

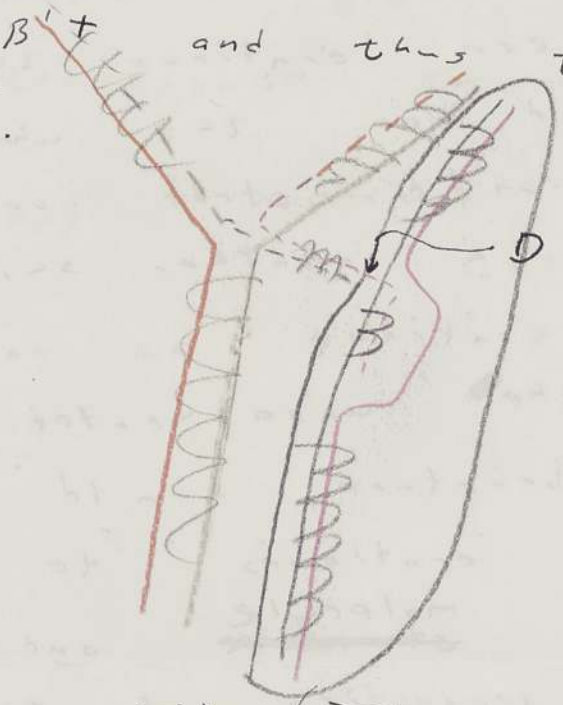
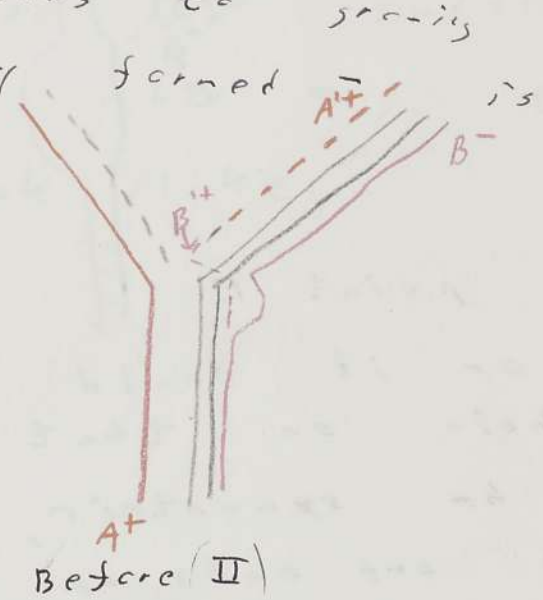
starting time is long compared to the running time so that there will only be one start in the process. If the start takes place on the upper end of A and pairing takes place



we will have the dotted line is the newly formed daughter which will be labelled with a prime

(I) The growing point C of A'^+ inserts itself between the chains of B and continues growing on B^- at this point it becomes B'^+ . B'^+ need only be wrapped about B^- for one or two turns and in this region B^+ would have unsaturated hydrogen bonds. This process can continue down the chains with A'^- growing on A^+ and $A'B'^+$ growing on B^- but winding around A^- . If this were to continue to the end it would lead to a heterozygous region (C) extending from the original switch point to the end of the molecule and such

structures are not found (at least to the level of 10^{-3} in phase). It also seems more likely that the growing point of A'^- should switch before very long since it is constrained by the rest of the structure to be near other + ~~strands~~ ^{chains} to which it could switch. The closest + to which it could transfer (and also the only one which leads to short heterozygotes) is the newly formed B'^+ . This then is taken as the second switching operation i.e. A'^- switches to growing about B'^+ and thus the newly formed $A'B'^-$ is

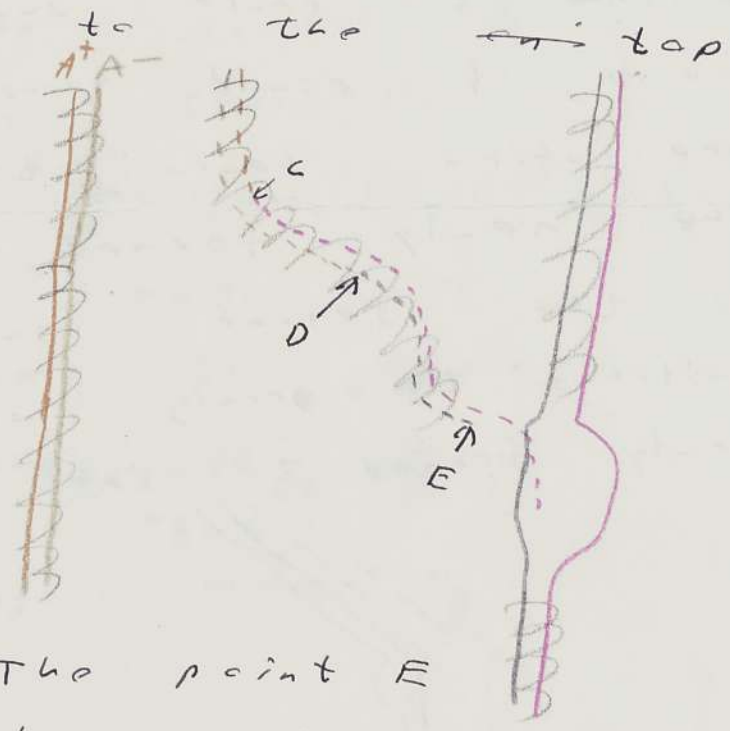


After (II) the structure plus the small amount of B'^- which is circled, (ie, B) to the rest by only a single phosphate-ester link at D. Therefore free rotation can take place about D. Any thermal motion which pulls B away will exert a tug on D and will cause $A'B'^+$ and $A'B'^-$ to pull away from A. These

two will then wind around each other and A^+A^- will re-wind so that there will be no net change in the number of saturated hydrogen bonds. No net energy is required except for the viscous drag and the gain is the free energy of separation.

When this back winding gets to the end of A one has:

At C the A^+ changes to B^+ and at D A^- changes to B^- . The new structure then can continue to the end or the whole thing could start over again with another switch. The point E could continue as indicated or it could insert into the unsaturated B^- chain so that the structure would then be symmetric.



If this continues to the end one ends up with one new molecule and it has all of the observed properties of the heterozygote.

Both Seymour and Murray Fox have seen this with beads in fact it was Murray's sister who asked the right questions to produce the scheme. Obviously there is no reason to believe that it has anything to do with reality except that it's the only one I've been able to find ~~ever~~ after a good deal of trying.

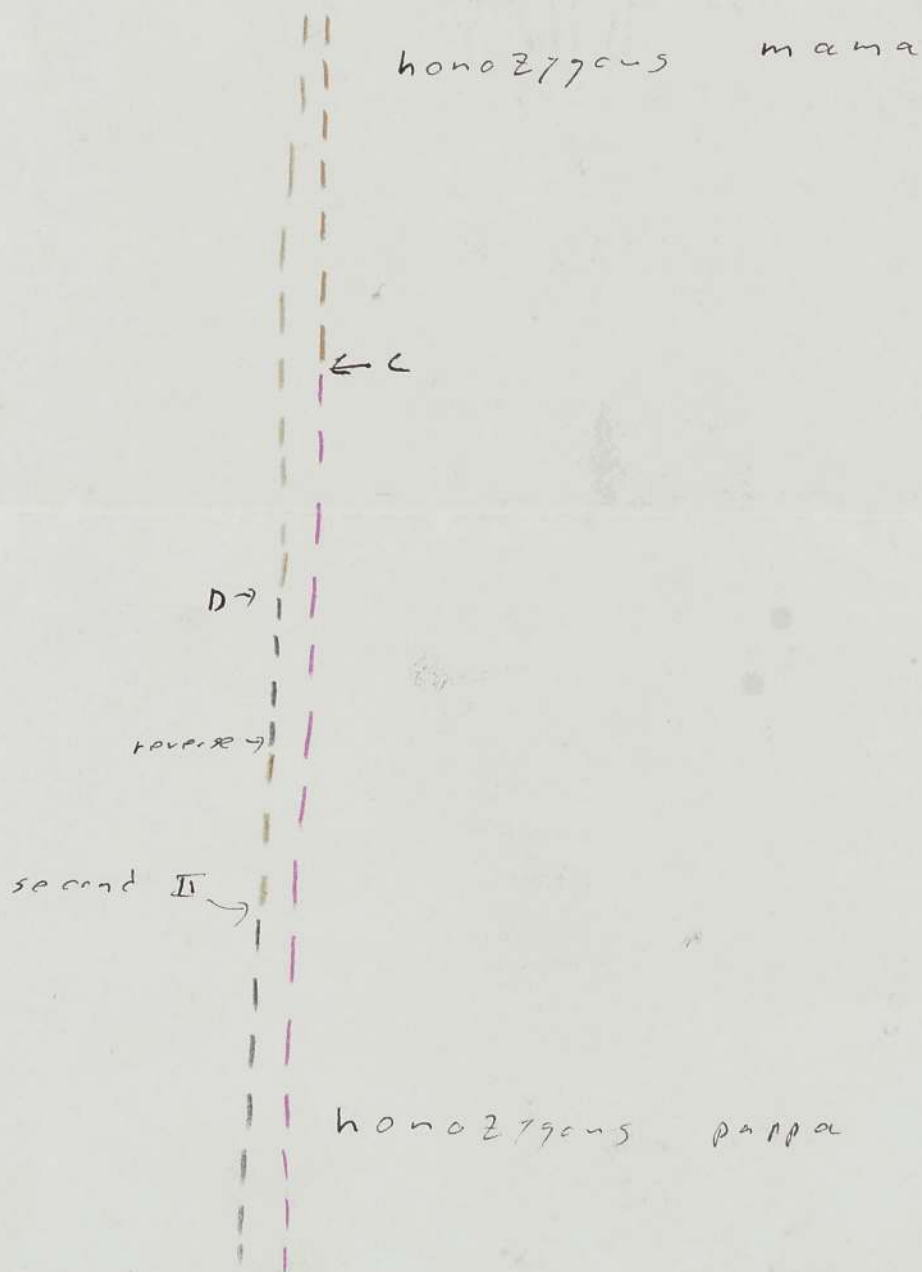
New experiments ~~draw~~ to the down the facts are in progress but nothing new to report yours

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P.S,
the apparent negative interference, that
is, the high probability of switching near
a switch come out of this a rather
natural way, If after the switch (II)
but before the back-inclining there is a
reverse switch of ~~B⁺~~ back to A⁺
then one must start over with a
type II switch before the separation,
In this way the heterozygote ~~is~~ could
look like



The left hand chain, that is the ~~second~~ ⁽⁶⁾ one which switched second, has three switches. The possibility of further switches is ended as soon as the back-winding starts so the switches are all clustered in the region between the first switch at C and the ~~B~~ start of the back-winding.

The testable predictions of this model are 1) that the length of the region containing multiple switches i.e. length of the negative interference region should be the same as the observed region of the heterozygote. 2) ~~The~~ All clusters of switches should contain an odd number of switches.

1) has recently been demonstrated by Doermann's lab but 2) has not yet been tested.

Yours



please let me know what you think of this.